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Cleaning Steel Castings--I

Importance of Cleaning Procedure Emphasized in Steel Foundry Practice—Gas Cutting Primary Operation—How Apparatus Is Handled and Cared for in Torch Department

BY HERBERT R. SIMONDS

IN STEEL foundry practice, molding and casting simply constitute a good start in the manufacturing procedure. The labor involved in cleaning steel castings often requires from 15 to 60 per cent of the total foundry labor required to turn out the casting ready to ship. At best, cleaning castings is an unpleasant job. The surfaces, in addition to a more or less complete sand scale, usually are covered with nails, chill plates and reinforcing wires. Nails are used to reinforce the surface of the molds and cores and also to act as a cooling medium at strategic points. Spiral chill wires sometimes are so arranged that parts are in the casting and parts in the mold and of course this arrangement means that each spiral must be cut after the casting is taken from the mold. In the production of steel castings, the head metal is large in proportion to the weight of the casting and this means more metal to remove through the general process known as cleaning. The broad term, cleaning, may be divided into four groups based on the principal tools and agencies employed. These include gas torch cutting; sand-blast cleaning; use of chipping tools; snagging, or grinding. The accompanying article on removal of gates and risers deals with the application of the cutting torch.

The design of headers for producing good steel castings and arrangement of headers for easy removal usually are in direct opposition, one to another. Recent molding practice has developed a header, which instead of having a neck at its base, spreads out to join the casting at the point of its largest cross-section, and this of course, means greater difficulty in removal. After steel castings are taken from the mold, the large risers or headers are usually the first metal to be removed through the cleaning operation. In the case of small castings, it is the practice occasionally to throw them direct risers and all, into the sand-blast barrel; but normally the removal of headers is the first cleaning operation. Cutting of excess metal from steel castings by means of the oxy-hydrogen or oxy-acetylene torch has become such a general practice that

FIG. 1—A TYPICAL OXYACETYLENE OUT-IN OPERATION

FIG. 2—SOME IDEA OF THE WORK IN CLEANING SMALL STEEL CASTINGS MAY BE GAINED FROM THIS VIEW OF A LARGE HIGH PRESSURE VALVE

the steel foundryman wonders how this work was done before the gas torch was developed. Fig. 1 shows an operator removing a riser from a large steel valve casting. In this particular case, the cut has an area 2½ inches x 14 inches or 35 square inches altogether, and under test the cut was made in 2 minutes and 55 seconds, or on a basis of approximately 700 square inches per hour. In one foundry, where the area cut and the time required have been watched over a considerable period of time, an average figure of 500 square inches per hour has been obtained. Of course, the time of cutting varies with the width of the section. Starting with narrow sections, the time per square inch for cutting decreases up to approximately 6 inches, and then increases for widths above 6 inches. One foundry using oxy-hydrogen equipment has conducted tests to obtain the cost for making 6 inch cuts. Based on 100 square inches, the cost for gas and for repairs to equipment was $1.05 and the labor 20 cents. As sections increase in width above 8 or 10 inches, the cost per square inch rises abruptly. Thus on a large rotor casting, 45 minutes were consumed in cutting off a riser 23 inches in diameter, and the cost for the work including the cost for gas, when reduced to a 100 square inch basis was close to $2.00, bringing the cost for removing this single riser to between $7.00 and $8.00.

Comparing this cost with the amount of work to be done in Fig. 3, will give some idea of the problems involved in cleaning steel castings and the opportunity for increasing efficiency in this field of foundry work. The casting in Fig. 3, weighs 18,000 pounds and has 19 heavy risers. In this case, the portion of the total casting represented in risers amounts to 36 per cent. In Fig. 1, the riser weighs 200 pounds and in valve work generally risers weigh from 30 to 50 per cent of the weight of the finished casting. The cost of oxy-hydrogen cutting, where the castings run from 1000 to 3000 pounds in weight has averaged 1.75 cents per pound of finished casting. This figure includes distribution of foundry overhead, but no general overhead. The distribution of costs on a casting somewhat similar to that shown in Fig. 2 was made as follows:

Metal in the ladle	2.25 cents
Molding cost	4.5 cents
Cleaning	2.15 cents
Rejections and losses	1.00 cents
Annealing	.50 cents
Total cost	10.40 cents

From this it may be seen that the cleaning amounts to about 20 per cent of the total production cost. For more complicated castings, this cleaning cost runs up to 50 per cent or more. On the casting shown in Fig. 4, which is a steel motor frame casting, weighing 1285 pounds, a gang of four men worked several days to clean and prepare the job for the machine shop. This particular casting was one of the first of this design to be poured, which accounts for the fin extending around the opening. Even with the amount of head metal shown, some shrinkage cracks developed and these had to be chipped out and filled in by the electric welder. On subsequent castings of this type, the head metal was increased and shrinkage difficulty eliminated. The gate in this particular case is known as a by-pass horn gate. The metal flows in at the bottom until it has reached the level where the gate comes in contact with the side of the casting, and at this point the metal is by-passed and runs in directly, thus permitting the hotter metal to flow directly into the mold. This is a case where good molding practice means more metal in gates and runners. These, of course, must be removed and this runs up the cost of cleaning. Good molds, carefully made,

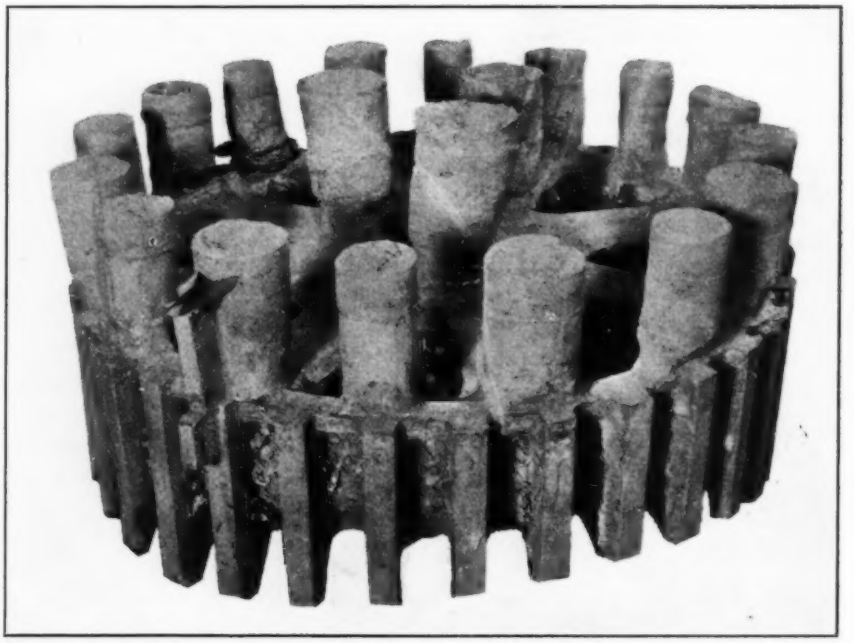


FIG. 3—THIS GIVES AN EXCELLENT EXAMPLE OF A LARGE AMOUNT OF METAL WHICH OFTEN MUST BE REMOVED ON STEEL CASTINGS—THE HEADERS WEIGH APPROXIMATELY 36 PER CENT OF THE ENTIRE PIECE

prevent fins and excess metal due to mold inaccuracy. Proper pouring also reduces cost of cleaning. If the metal is too hot it scores the sand or eats in slightly over the face of the mold, causing a rough casting. Some of these points will be considered at greater length under the discussion of the snagging and sand blasting operations.

Design of Headers

While the location of headers largely is a matter of molding practice, it is important that the foundryman, when he lays out the design of each header, keep in mind the cost of removing the excess metal, because it is almost always possible to make certain modifications in location or dimension which, while not effecting the best molding practice, will facilitate the removal of the header. This is better indicated by taking an example as shown in Fig. 7. Here the header is cylindrical, but joins the narrow flange in an expanded neck as shown. The header instead of being set squarely on the flange is offset so as to give a definite and clearly defined line which acts as a guide for the cutter. In more complicated sections than this, the guide feature in the design of headers is often more important.

Of course, the first consideration in the design of a header is that it shall properly shrink the casting. This is a matter determined largely by experience. The joining of small sections to large sections in a casting always develops a tendency for the small section to shrink away from the large and produce a crack. The large section near the point of junction must be fed with sufficient hot metal to overcome this shrinkage. Having determined the nature and location of the header to prevent defects due to shrinkage, the question of how that header is to be removed should next be considered. Sometimes through neglect of this point, headers have been placed in such a position that they can not be reached with the gas torch. Usually this difficulty can be overcome with a little preliminary study of the problem.

FIG. 5—FOR THIN SECTIONS ON SMALL CASTINGS, THE SPRUE CUTTER IS USUALLY THE MOST CONVENIENT MEANS OF REMOVING GATES AND HEADERS

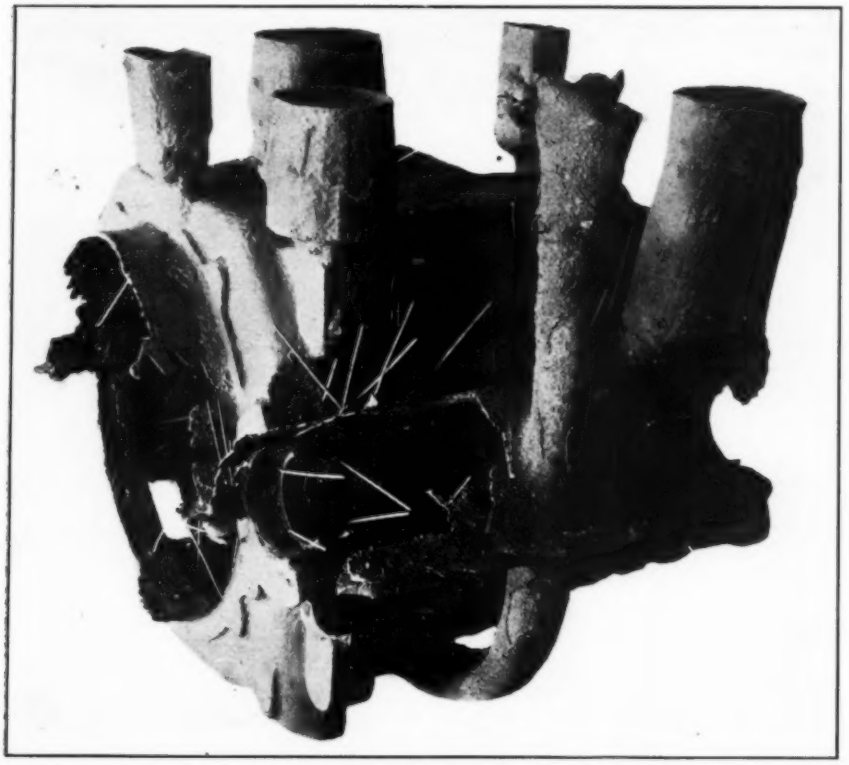


FIG. 4—MORE CAREFUL MOLDING PRACTICE WOULD HAVE ELIMINATED THE FINS ON THIS CASTING AND THUS REDUCED THE WORK OF CLEANING

Effect of Temperature

Usually, high temperatures increase the cost of cleaning. Higher temperatures mean larger headers, and further, as has been mentioned, hot metal burns into the sand. Temperatures should be suited to the casting. A large casting should be poured at a lower temperature than a small casting and the smaller forms of molds usually will take a lower temperature metal from the ladle, than will more complicated designs. It is not advisable, of course, to overdo low temperatures, but often a little more work in modifying a mold, that is, in placing runners between thin sections and perhaps increasing size and number of gates, is warranted in order the lower temperature metal may be used in pouring. Fig 8 shows a high pressure steam turbine head in which the steel must be uniform and absolutely flawless. This particular casting must stand a working pressure of 280 pounds of superheated steam and must meet government specifications. The weight of this casting, finished, is 10,710 pounds. The weight of the heads is 10,806 pounds. The time required to clean, and complete is 75 man

hours and of this amount 5½ man hours is for gas cutting. The location of headers in this case has been the result of experiment and much study. The question of their removal was taken into account but features of the design to facilitate low temperature pouring were the more important consideration. This was to preserve a good surface in places which were steel sections up to 2 inches in diameter is more economically done with oxy-acetylene torches. Above 2 inches the oxy-hydrogen apparatus is considered less expensive and the difference is more pronounced as the width of section to be cut increases. In foundries having both small and large work to cut, the most economical system would seem to be to divide the work into two groups, cutting with acetylene in one, and with hydrogen in the other. However, the presence of both of these gases in the same building greatly increases the danger and therefore one or the other system usually is selected for the entire installation. Success with any cutting apparatus largely is dependent upon the care of the operators, close observance of instructions and upon frequent inspection. Through the courtesy of the General Electric Co., suggestions are offered to those operating gas cutting systems. These instructions are the result of study extending over a three-year period during which time ideas from all departments and from all those in any way connected with the cutting operations were carefully weighed. Accidents were analyzed as to causes, and the entire fund of information boiled down to the limit. These instructions are summarized in the accompanying Table I. The instructions issued to those in attendance at the storage supply houses and cutting stations are given in Table II. Some foundries conduct schools of instruction in gas cutting. Others post at convenient points about the plant brief instructions printed on cards. One such instruction card, giving directions for using gas is shown in Fig. 6.

TABLE I

Instructions for Operators of Gas Cutting Apparatus

Starting The Day's Work

THE following precautions should be taken before starting work each day. Examine all bubble bottles to be sure they are full of water to upper valve and in working order. If necessary to fill water bottle, be sure valve on line is closed before proceeding. Test discharge pipe from safety valve for leaks on both oxygen and hydrogen lines with cup of water held at end of pipe. Also note that regulators are not leaking or building up pressure. Never use anything but water when testing for leaks. Examine torches and tips to see that they are not plugged up. Examine all regulators for signs of oil or grease, especially oxygen lines. Blow out both hydrogen and oxygen lines in torch before lighting. The following method should be used in lighting torch preparatory to starting cutting:

Open hydrogen valve and light with gas lighter furnished. Never use anything else to light gas. Open pre-heating oxygen valve until proper mixture is obtained. Properly adjusted, the two cones of gases should just merge into one, about ½ inch from end of tip. Open high pressure oxygen valve and if necessary make further adjustments to bring cone and flame to proper point. The length of cone and flame depend on thickness of metal to be cut. After finishing cut, both oxygen and hydrogen flames should be shut off where there is to be any delay in starting another cut.

General Precautions

Never allow end of tip to come in contact with metal which is being cut, as this may cause a flash-back or plug up tip. If at any time a pocket is formed due to sand or blow holes do not continue to puddle, but start cutting where clean metal can be cut. Should flash-back happen or any unusual noise occur in regulator, operator should shut off immediately and notify man in charge.

When finishing work for the day, line should be drained of any gas and pressure released on regulator. Cutting apparatus and hose should be carefully put away each night in cages and these should be locked.

A metal screen should be used at all times to protect fellow workmen from flying sparks. Never use anything but the gas lighter furnished, to light gas.

Care should be taken to prevent hose from being cut or otherwise damaged while in use. Proper precautions should be taken to protect the hose from flying sparks or open flames. All hose should be examined periodically, at least once in two weeks. This should be done by cutting the hose off about two inches back of the connection and examining it for deterioration or defects. A defective hose should never be used. Special care should be taken to avoid the interchange of oxygen and hydrogen hose or piping, as this might result in a mixture of these gases that would be highly explosive. Operators should be provided with welding goggles of an approved type.

Instructions for Coupling Tanks to Manifold

Couple tanks to manifold with all valves closed and pressure volve on regulator relieved. First open manifold valve slightly; then open tank valve slowly until entirely open; then open manifold valve wide. Adjust valve on regulator to give necessary pressure, not to exceed 180 pounds on oxygen line and 80 pounds on hydrogen line in supply houses. Tag marked "Full" should be removed when tank is opened to manifold. Not more than two tanks of gas should be open on manifold line at any time. While gas is being used from tanks on line three more tanks or less may be coupled to manifold, but neither valve on manifold or tank should be open. When manifold gage on high pressure line shows pressure reduced to 100 pounds on oxygen line and 35 pounds on hydrogen line, valves on manifold tank should be closed, pressure valve on regulator entirely released, and new tanks of gas opened up on manifold. Tanks taken from high pressure line may be coupled to low pressure line in order to utilize such gas as is left in tank. The same procedure also should be followed on low pressure lines with the exception that tanks need not be changed until manifold gage shows a pressure of 60 pounds on oxygen line and 20 to 25 pounds on hydrogen line. Tanks should then be disconnected and returned. Bubble bottles must be thoroughly inspected and filled each day if necessary, before starting work. When work is completed for the day, all valves on tanks must be closed and after line has been drained by operators, close manifold valves and release pressure valve on regulator. All tanks while coupled to manifold must be securely held in place by iron frame work provided.

General Instructions, Tanks and Manifolds

The storage buildings should be provided with electric lights placed in vapor proof globes, all wires to be placed in conduit and all switches located outside the buildings. Great care must be exercised to prevent grease, oil or soap coming in contact with oxygen tanks or equipment, as this might cause spontaneous combustion. Oxygen and other pressure tanks should not be allowed to remain near stoves, furnaces, steam heaters, or other sources of heat, and should not be exposed unnecessarily to the direct rays of the sun, as an increase in the temperature of the gas will cause a corresponding increase in the pressure within the tank. Any excess of heat may also soften the fusible plug with which the tank is provided, causing it to blow out thus permitting the gas to escape. White lead, grease, or similar substances should never be used for making tight joints. All joints and leaks in equipment should be made tight by soldering or brazing. All lines and equipment to be thoroughly inspected each week for leaks and report made out. This report should be signed by all concerned in the inspection.

not to be machined and which were difficult to reach with snagging wheels.

A new steel foundry which is starting operations will consider new problems in connection with cleaning castings. One will be the selection and design of gas torch cutting equipment. Many types of cutting apparatus are available. These fall under one of two classes; those which use acetylene gas and those which use hydrogen. Generally speaking, cutting

The disposal of the headers after they have been cut from the castings often presents a problem in handling material. These headers are used in charging the furnace and the problem is therefore to get them from the cleaning floor to the charging floor. Where charging machines are used it is often found convenient to have extra charging boxes placed close to the castings which are being cleaned on the cleaning floor. When the headers are cut off they are placed in these charging boxes and subsequently picked up by crane and carried to the furnaces. Large headers often will not fit in the usual type of charging box and when this is the case, a flat slightly dished tray sometimes is used in place of the boxes. Such trays are provided with holes so that they may be picked up by the crane hooks and also have the usual locking device for the charging machine. Whatever the system of charging, it pays in the cleaning room as well as in other departments to have receivers conveniently placed near the work so that part of the work of taking away the excess material may be accomplished as the cutting progresses.

Using Sprue Cutters

So far, the gas torch has been spoken of as if it were the only means of removing headers but of course there are other means. For small sections, an excellent tool for removing headers is the sprue cutter. One such cutter is shown in Fig. 5. This particular machine has a capacity

INSTRUCTIONS

FOR THE USE AND HANDLING OF

OXYGEN, HYDROGEN AND ACETYLENE GAS APPARATUS

TO AVOID EXPLOSIONS

DON'T	**Use Oil, Grease, White or Red Lead or any Lubricant on Tanks, Piping, Valves or any other Fittings or Connections in any of the apparatus.**
DON'T	**Touch Tank Valves or other Fittings with Greasy Hands or Gloves. To do so may result in an explosion.**
DON'T	**Open Tank Valves Rapidly**
DON'T	**Hammer or allow anything to Strike against Valves or Fittings.**
DON'T	**Throw or Jar Tanks. It may cause an explosion.**
DON'T	**Allow Tanks to Remain in the Building after working hours; remove them to a Safe Place Outside in the Open.**
DON'T	**Expose Tanks to Sun or Excessive Heat.**
DON'T	**Allow anyone to Meddle with or attempt to Repair any part of the apparatus. Notify Foreman of the Welding and Cutting Dept., Bldg. 8-A, promptly or return apparatus to him for necessary repairs, which will be done by experienced men.**
DON'T	**Under any circumstances attempt to Fill any Oxygen, Hydrogen or Acetylene Gas Tanks with Any Other Gas than that originally intended for and marked on each Tank, nor use any Tank for Any Other Purposes.**
DON'T	**Connect Tanks to other apparatus, before seeing that Valves Work Freely.**
DON'T	**Fail to Close Valves on Tanks when same are Empty, Replace protector cap immediately, and Return Tanks to Gas Plant, Bldg. 12-annex, to be refilled.**
DON'T	**Attempt to connect a Tank, Regulator, Pressure Gauge, Hose, Pipe Fittings or any other Gas Apparatus to that which has been filled with any other gas. It may cause an explosion.**

FIG. 6—INSTRUCTION CARDS SIMILAR TO THIS PLACED IN PROMINENT PLACES OFTEN ARE THE MEANS OF PREVENTING ACCIDENTS

TABLE II

Instructions for Attendents at Storage House and Cutting Torch Stations

ALL tanks as soon as received and before being put in the storage houses, should be carefully examined for leaky or defective valves. All threads should be carefully examined and any questionable tanks should be tagged, showing the trouble, and returned. All tanks of gas, both hydrogen and oxygen, should be tested for purity of gas before being stored in building, a tag being fastened to the valve showing result of test. Oxygen and hydrogen tanks should never be dropped or handled roughly, and when stood on end should be fastened in such a manner as to prevent them from falling over.

No two kinds of gases should be stored in the same storage building. When transferring tanks of gas from storage houses to supply house, carefully examine valves and threads before coupling to manifold. Valves on tanks should be opened slightly to clean out same before coupling to manifold. No tank of gas should be used where unusual exertion is necessary to couple to manifold. Before opening valve on tank to the manifold, be sure pressure valve on regulator is entirely relieved. Tags showing purity of gas should not be removed from tank until same is empty. Tags should then be filed for possible future reference. Approved fire extinguishers should be furnished and kept in cages and houses for use in case of need. Only steam or hot water shall be used for thawing frozen valves.

No repairs to tanks or equipment should be attempted. When a leak is discovered in a tank of hydrogen or other inflammable gas, the tank should be placed in the open air, the valve opened and all open lights kept away, until the gas has escaped. All open flames should be kept away from any place where there is any possibility of hydrogen gas escaping.

Care should be taken to prevent the discharge valves of tanks from being bumped, as this may damage the valve and cause it to leak. The regulator should be handled carefully, as its delicate mechanism is easiy injured. Always relieve pressure on regulator whenever work is to be discontinued for any period of time exceeding a few minutes. The valves on the tanks should be operated slowly, and care should be taken to avoid straining or damaging them by use of a hammer or improper wrench. A special wrench should be made for use in opening these valves in case they stick. The operator should not stand in front of the gages on the regulator when opening the discharge valve of the tank. Smoking while on duty should be positively prohibited. In case of fire in plant at any time all valves in oxygen and hydrogen houses should be closed and remain closed until authorized to open by the chief of the fire department, or his assistant. Attendant in charge of either the oxygen or hydrogen house must under no consideration allow house to remain without an attendant while gas is being supplied to the line. Constant watch must be kept on the pressure regulating valves so as not to allow pressure to fall below the point indicated when tanks are to be removed from either high or low pressure lines.

for 3-inch round steel and is a decidedly useful tool in any steel foundry where castings are small enough to be easily handled and where the gate and header sections are not much over 1 inch in section. Where sections are larger than 1 inch or 1½ inches, the use of a sprue cutter, however great a capacity it may have is apt to wrench or strain the casting itself. The operation shown in Fig. 5 is typical of those which advantageously

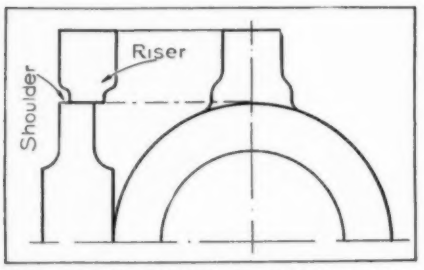


FIG. 7—THE DESIGN OF HEADER MAY OFTEN BE ARRANGED SO AS TO PROVIDE A GUIDE LINE FOR THE CUTTER TO FOLLOW

use a sprue cutter. In this particular case, the small castings are run through quickly. Thirty seconds are required for the operator to pick up the casting, make the four cuts required, and return the casting to a container. Power saws often are used to advantage when rate of production is low, so that time is not a big element in the foundry operation.

Arc welding or gas welding is closely associated with cutting operations. However, as the use of welding apparatus is to build up rather than remove metal and in most foundries is performed after chipping, the consideration of this equipment will be taken up in a later article.

Predict Future of Electrical Heating

Electricity is destined to be the future fuel in industry according to Frank W. Brooks, chief engineer of William Swindle & Bros., Pittsburgh, who spoke recently before the New England Foundrymen's association at the Exchange club, Boston. The subject of his paper was, "Electricity in the Foundry," but before taking up this specialized subject, Mr. Brooks told of the diminishing supply of natural gas and fuel oil and the resultant increase in the cost of these two fuels; also, but to a lesser extent, coal and coke are bound to increase as years go on and the more easily reached supplies diminish. The cost of electricity on the other hand is bound to be reduced.

One interesting use of electricity for fuel is in the reclaiming of scrap such as borings and turnings. In the Ford Motor Co. plant at Detroit, some 200 tons of borings are accumulated each day, and because of transportation difficulties and low market these borings are not being disposed of, but are held in a huge storage pile containing at present 150,000 tons or more. The use of these borings in a blast furnace or in almost any type of furnace except the electric furnace is exceedingly wasteful of the metal.

Another use of electricity which Mr. Brooks feels will develop rapidly in the next few years is the pouring of castings from blast furnaces through the intermediate use of an electric furnace. At present the procedure is to cast pigs at the blast furnaces. These are then shipped to the foundries where they are remelted in cupolas. In the scheme which Mr. Brooks outlines the original heat in the blast furnace will be saved and the necessity for reheating in a secondary process will, therefore, be eliminated. Mr. Brooks covered the subject of electricity in the foundry under three divisions, first, low temperature heating for drying cores and molds and patterns; second, the higher intermediate temperature work such as annealing and tempering, and third, the melting at high temperature.

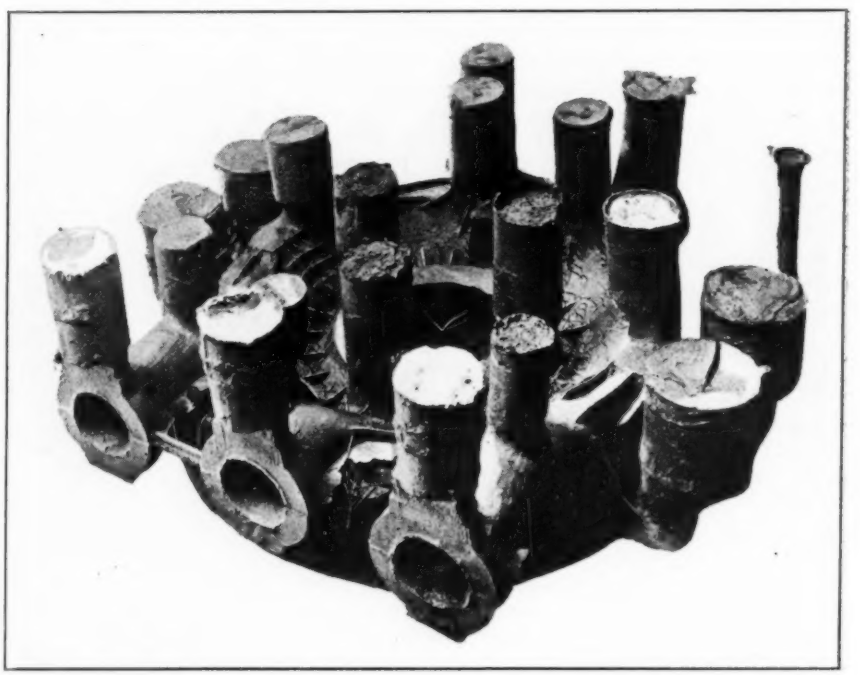


FIG. 8—THIS CASTING IS DESIGNED TO WITHSTAND A WORKING PRESSURE OF 280 POUNDS OF SUPERHEATED STEAM AND THEREFORE MUST BE ABSOLUTELY FREE FROM SHRINKAGE CRACKS

Claims Desulphurizer Is of French Origin

To The Editor—An editorial in The Foundry of March 1 refers to a new process for reducing the sulphur content of iron by using a ladle addition, and credits this process to German invention. May I point out to you that this process did not originate in Germany.

As far back as 1917, during the war, we had to find means in France to purify gray-iron and semisteel castings and a flux for desulphurizing and deoxidizing the metal was originated. This product has been used considerably since the war in industrial operations.

Of course, the application of this process requires some care and attention as the flux must be added little by little in the ladle while pouring; but after all this operation is inexpensive and the results obtained more than compensate for the trouble.

Edouard Hirsch.

Electrochemists Meet

Technical sessions in connection with the convention of the American Electrochemical Society, May 3, 4 and 5 will be held in the Commodore hotel, New York. On Thursday and Friday papers and discussions will be heard on electrode potentials. Included in this group is a paper, Electric Furnace Detinning and Production of Synthetic Gray Iron from Tin Plate Scrap, by C. E. Williams, C. E. Sims and C. A. Newhall. On Saturday papers and discussion will be confined to production and application of the rarer metals.

Social and entertainment features in connection with the convention will include a luncheon and plant inspection tendered by the McGraw-Hill Co. on Thursday and a theater party the same night, and an excursion to Westport, Conn., on Friday where the visitors will be luncheon guests of the Dorr Co., and afterward inspect the plant.

Theorizes on Cupola Reactions

Work of Different Investigators Reviewed To Show Location and Effect of Melting Zone—Flexibility of the Cupola as Melting Furnace Is Pointed Out—Slag Reactions Cited

BY S. J. FELTON

THE only records based on actual measurement of gases and temperatures existing in the cupola furnace, so far as the writer has been able to discover, are given by Belden, an average of his results being indicated in the accompanying illustration. As Belden was not satisfied with the accuracy of these temperature measurements which were obtained by the use of an optical pyrometer, and as attempts to use a thermocouple met with failure, he devised a method for obtaining relative temperatures. This method consisted of measuring heat absorbed by water which circulated through copper tubes inserted into the fuel bed. The results of this test, along with consideration of gases, indicate probable points of highest temperature, as shown in *B* by dotted line.

Belden made the following statements: "If it were possible so to charge the cupola that melting would take place along or just above such a line (or, rather surface) ideal results would be obtained both as regards temperature and absence of oxidation. Since it is not possible to confine melting to this irregular region, the best condition for melting is obtained at that section across the whole of the fuel bed that shows the highest temperature together with absence of oxygen (this condition existing) about 20 inches above the tuyeres. In some region above this zone of highest temperature the temperature is still high enough to melt iron, but is not high enough to impart heat quickly and to give hot iron. This melted iron passes through the lower zones, although the temperature of these zones be exceedingly high, too rapidly for the absorption of enough heat to raise its temperature materially, and cold iron is the result. The experiments here reported confirm the general opinion that the hottest part of the cupola is where the lining is most burned out."

Tests Run Without Iron

As Belden melted no iron in his test, any reference to this phase of operation on his part must be pure conjecture, particularly in regard to superheating effect. Although it is reasonable to believe that the zone he mentions should give maximum practical melting efficiency, his arguments on hot and cold iron seem erroneous. Any superheating effect must naturally take place after melting, and, if the maximum temperature zone is used for melting, its enormous superheating effect is lost, while if the iron melts above this zone, its superheating effect is utilized. The effect of the high temperature zone on the lining has been misconstrued by many to represent the eroding action of the iron on melting.

Cupolas Flexible

Moldenke* supports Belden's conclusions, but as he recommends melting rates which are below the maximum attainable, it is apparent that in his practice he does not melt in the CO_2 zone. He also gives some interesting *B.t.u.* calculations showing drop in quantity of heat when excess coke is used. Unfortunately there is not necessarily a relation between *B.t.u.* developed and superheating effect, in cupola operation. When excess fuel is used the gas producer effect ($CO_2 + C = 2CO$) causes loss of heat only above the CO_2 zone, and according to Moldenke's conception of melting, this would simply affect the preheating of the solid stock. As Riddell* has been experimenting to increase tapping temperatures by cutting down this preheating effect through use of wet coke it would seem as though there is some question as to the exact effect of the gas producer action.

Riddell* places great stress on the difference in melting and freezing points of gray irons as a means of superheat. He believes high tapping temperatures are obtained only through the use of heat melting point irons with special precautions to retard increase in combined carbon content. If Riddell's theory has the weight he attaches to it, low charging doors or stock level should be advantageous, as the quicker the iron can be melted the less will be the increase in combined carbon which lowers the melting point. Dyer's* statement in respect to coke saving by use of low melting point chill pig would seem unfavorable from a tapping-temperature standpoint in the light of this theory.

Observations and tests covering several years have convinced the writer that cupola operation is capable of great flexibility. He has observed tapping temperatures within the range given by Elliott* as representing excellent cupola practice, from stacks with low and high charging doors, the charging conditions in some cases being quite lax. Using an improved type of optical pyrometer, giving accurate temperatures of molten iron, he has observed uniformly high temperatures in heat after heat, in spite of certain variations in weather conditions, coke, pig, scrap and charging. As this uniformity in the face of these variables is in direct contradiction to present theories on melting and superheating, it would appear as though present hypotheses should be altered to conform to observations.

High Temperature Necessary

If iron melts in a restricted zone, according to present theories, a high-melting-point iron would necessarily have a higher tapping temperature than a low-melting-point iron, because it would start on its molten journey at a higher temperature and would be subject to the same superheating effect as low-melting-point iron. As the writer has demonstrated many times to his own complete satisfaction that the same tapping temperatures are obtained when using either low-melting-point chill pig or high-melting-point sand-cast pig, the question naturally arises as to where the additional superheat is gained by the low-melting-point pig. The accompanying chart shows that a temperature of 2800 degrees Fahr. exists 26½ inches above the tuyeres, and undoubtedly temperatures well above the melting point of iron exist many inches higher up. Therefore, it is reasonable to believe that low-melting-point pig iron will melt higher in the stack than high-melting-point iron. The greater distance the molten iron drops through the hot zones gives it enough superheat to make up for the lower melting point. Chilled pig iron can be melted with less coke than sand-cast pig, as mentioned by Dyer*, but if the coke is cut, melting takes place lower in the stack, causing low tapping temperatures.

Bulletin 54, United States bureau of mines.

Principles of Iron Founding.

THE FOUNDRY, Oct. 15, 1921.

The Fluidity of Molten Cast Iron, THE FOUNDRY, September, 1918.

Foundry Pig Iron in Birmingham District, *Iron Age*, April 7, 1921.

Superheating Iron Electrically, *Iron Trade Review*, Oct. 20, 1921.

Foundry Pig Iron in Birmingham District, *Iron Age*, April 7, 1921.

The cutting of coke to such an extent as to give maximum melting efficiency, with no excess, and the keeping of a delicate balanced condition recommended by some authorities is impossible in cupola operation, and all cupolas giving satisfactory results are using excess coke. Excess coke slows up melting speed, but the charges melt relatively higher in the stack, thus causing a longer drop and more superheat to offset the relatively greater heat-loss to slag and lining. The amount of excess coke necessary is inversely proportional to the degree of maintenance and supervision of charging conditions and selection of raw materials, other things being equal, and might be considered by some as a question of costs. Excess coke is a safety measure and will offset to a certain extent uneven charging, use of large chunks of metal, and variation in materials. Of course, if too much excess coke is used, the effect on the temperatures of the CO, CO_2 zone, coupled with slowing up of the melting speed, will cause lower tapping temperatures. The writer's experience indicates that the melting speed may be slowed up considerably without affecting the tapping temperatures.

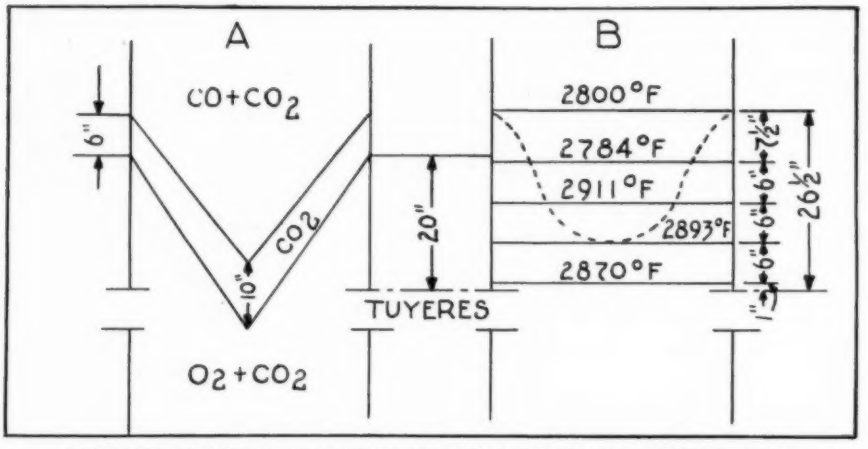


DIAGRAM SHOWING PROBABLE MELTING ZONE AND TEMPERATURES

Although a firm believer in blast-meter control of cupola air, the writer has seen high temperature heats produced with the pressure kept constant through the greater portion of the heat. The main factor which allows pressure gage control is that the blast volume ordinarily decreases throughout the heat, thus giving the same safety effect as excess coke. When the stock level starts to lower at the end of the heat, the volume increases, but this is generally offset by cutting the pressure when charging ceases. The large volumes at the start of the heat are usually offset by putting in a heavy bed, and incidentally, the large quantity of heat developed, along with the high melting speed, quickly warms up the relatively cool furnace. However, occasionally stack conditions may exist which cause raising of the volume during the heat, which naturally causes trouble. Therefore the use of the volume meter represents much more uniform practice.

In a cupola and auxiliaries of proper design and installation in charge of a good cupola tender, high tapping temperatures will probably always be obtained with the usual materials charged as long as a moderate excess of coke is used, and a connected CO_2 zone exists across the fuel bed. Moderate excess of coke is defined as that necessary to prevent solid material existing below the CO_2 zone.

The one extreme by which a connected CO_2 zone may be eliminated is through the use of exceedingly low blast volume or fine coke, or low density coke of medium or small size. Any of these conditions causes almost instantaneous existence of O_2, CO_2 and CO in close proximity to the tuyeres. This cuts down the temperature and depth of high temperature zones, thus eliminating proper superheat on that score. The lower melting rate along with greater distance to be traveled by the solid charges before melting, reduces the high-melting-point metals to a common level with the low-melting-point metals, eliminating proper superheating from that source. Even if a high-melting-point metal got low in the stack without decreasing its melting point the temperatures would probably be too low to melt it until its combined carbon increased to the extent necessary. The fact that the high pressures developed in the use of fine coke necessitates lowering the blast volume, is the reason why this fuel is unsatisfactory for high tapping temperatures. It is probably possible with low density coke of large size to raise the blast volume sufficiently to maintain a connected CO_2, but it is impractical unless the coke size is exceedingly large and strong enough to prevent crumbling. This is due to the enormous quantity of fuel needed, and to the great waste of heat on account of high velocity of gases.

The other extreme by which a connected CO_2 zone may be eliminated is by use of exceedingly large coke of high density. Incomplete combustion exists and the CO_2 zone is theoretically raised above the stock level, that is, if we assumed the stack to be full of coke, above closed charging doors. It would obviously be impossible in this case to use excess coke in practice.

Keep Carbon Dioxide Bed

As long as a connected CO_2 zone exists across the fuel bed with excess coke, it would seem practically impossible to force solid metal through it; however, if sufficient coke is used, the bed is lowered and solid metal exists below this zone, partially because the zone jumps the metal charge to the intermediate coke charge above. In this case oxidized iron, and low tapping temperatures will ordinarily exist because melting and superheating must take place in the relatively cooler O_2, CO_2 zone. The heroic attempt of the cupola to compensate for this lowering of temperature by greater oxidation of silicon, manganese and sometimes sulphur, is usually in vain. However, the writer recalls melting a high manganese special iron in which the oxidation of a large percentage of manganese caused raising of the tapping temperatures several hundred degrees. The only method the writer has found successful in determining the melting conditions throughout a heat is the taking of samples at definite intervals and analyzing them separately with a view to noting silicon and manganese losses. Although a certain variation is to be expected in these analyses, any improper stack conditions easily can be detected, particularly if these results are supplemented by records of temperature, melting rate, etc.

The erroneous assumption that the melting of iron in a cupola is confined to the restricted zone where the lining is most burned out has given rise to many preconceived notions as to the tapping temperatures of irons with different melting points. The contradictory opinion on the effect of various cupola conditions upon tapping temperatures are due in a large part to these preconceived notions coupled with the unreliability of using the human eye for comparisons in judging temperatures. Fluidity is the greatest obstacle to judging the temperature of molten iron. The theoretical effect of excess coke on *B.t.u.* developed has been overemphasized, as applied to cupolas, and far from being a detriment, the use of moderate excess coke is a beneficial safety measure. We frequently hear testimonials of big savings made by cutting coke, but many overzealous foundrymen cut coke where coke has already been cut to the safe limit. Kirk* has stated that less fuel is generally required to melt iron in the foundry office than is required to melt it in a cupola.

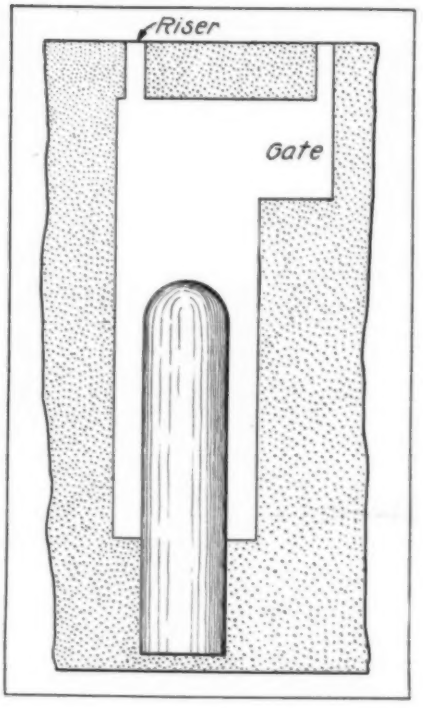
Iron Trade Review, Feb. 23, 1899.

Trouble from Shrinkage

Question: I am enclosing sketch of a casting which is causing considerable trouble by blowing off the chill when poured in the position shown. It is poured through a deep narrow gate and a riser is taken off the top. I have cast some of them in an inverted position with the chill hanging in the cope and they were satisfactory. It is troublesome to mold them that way and I would appreciate any information that would aid me in casting them with the chill resting in the drag.

Answer: We are inclined to think that your trouble is due to shrinking and not to blowing. You state that the castings can be poured satisfactorily when the mold is inverted, therefore the chill cannot be the cause of the trouble. If it were, the gas would show in a more pronounced form in the thin section around the chill than it would in the comparatively heavy body of iron above the chill when the casting is poured with the chill in the drag.

To prevent the casting from shrinking place a large riser on the top, use a feeding rod in the riser until the metal sets and the casting will be solid.



LARGE BODY OF METAL ON TOP REQUIRED TO COMPENSATE FOR NATURAL SHRINKAGE

Electric Steel Founders Hold Convention

The Electric Steel Founders' Research group held a convention at East Aurora, N. Y., April 13 and 14, at which a total of 26 representatives from the five member foundries were present. Papers were presented on casting and cost problems by different members of the organization, among whom were W. H. Worrilow, president, Lebanon Steel Foundry, Lebanon, Pa.; W. J. Nugent, vice president, Electric Steel Co., Chicago; T. S. Quinn, treasurer, Lebanon Steel Foundry; L. S. Peregoy, Sivyer Steel Casting Co., Milwaukee; J. C. Redmond, Michigan Steel Casting Co., Detroit; C. R. Messinger, vice president, Sivyer Steel Co.; and H. J. Koch, secretary, Ft. Pitt Steel Casting Co., McKeesport, Pa. W. J. Corbett, industrial engineer of the group, spoke on new uses for electric steel castings, and R. A. Bull, research director of the group, spoke on the various phases of research being conducted by the member foundries. A banquet was held at which E. J. McCone, editor of the *Buffalo Commercial* was the principal speaker.

Fifty Causes for Defective Steel Castings

BY MICHAEL R. BURNS

CONSIDERING the almost innumerable number of causes responsible for defective castings one is led to wonder not at the percentage of lost castings, but rather that the number of good castings is so gratifyingly high. The production of castings hinges on the most complete and intimate co-ordination between the methods of the molder and the melter and the slightest inattention to detail on the part of either one nullifies the best effort of the other. From the accompanying list it will be noted that the faults due to omission are about equal to those due to commission, and while many may be listed in the preventable class, a considerable number still are in that vague category usually referred to as causes beyond our control.

1 Work done by incompetent or careless molder.
2 Unsuitable facing sand.
3 Green sand molds rammed too hard.
4 Green sand molds rammed too soft.
5 Molds not vented properly.
6 Molds not dried sufficiently.
7 Molds over dried and burned.
8 Dry molds not properly loaded.
9 Molds shifted in closing.
10 Chaplets too few, too small or not properly secured.
11 The use of defective flasks.
12 For want of gaggers or other support sand drops after mold is closed.
13 Insufficient or careless clamping resulting in a runout.
14 Guessing at the volume of metal in a ladle and pouring a mold short.
15 Gates injudiciously placed.
16 Heads not in proper places.
17 Fillets too small.
18 Heads too small to feed casting.
19 Heads so large they crack small castings.
20 Trying to make long castings in dry instead of green sand molds.
21 Molder not instructed where to cut brackets.
22 Hard cores which crack castings.
23 Soft cores which cut away in large heavy castings.
24 Cores not properly rodded to resist pressure of metal.
25 Cores not vented in a suitable manner.
26 Half cores not pasted securely together. Where rod only appears in one half, the molder sometimes places core in the mold with unsupported side down with the result that it drops off.
27 Cores only partly dried.
28 Burned cores on which molder takes a chance.
29 Unsuitable core sand mixture.
30 Silica wash applied too thickly; chips and comes to surface of casting.
31 Slag in metal.
32 Metal which is duller than it appears.
33 Metal poured too fast which strains mold, or poured too slow and does not run casting.
34 Omitting to feed a casting which requires such treatment.
35 Ignorance of feeding methods on part of operator.
36 Omitting to nail certain surfaces on green sand molds.
37 Omitting to put horse shoe nails in small hubs.
38 Placing rusty nails in mold.
39 Omitting tinned rods at points where segregation or cracks otherwise will appear.
40 The use of rusty rods.
41 Dumping molds before metal has set.
42 Omitting to dig around heads after casting is poured to provide for contraction.
43 Omitting to dig out cores in certain cases promptly.
44 Taking a chance with a shallow drag. Usually results either in a scabbed casting or a runout.
45 Half patterns not matched accurately on machines.
46 Loose pins which result in mismatched castings.
47 Worn pin holes, same result.
48 Leaving copes standing too long on one side resulting in distortion.
49 Green helpers placing weights on molds frequently knock sand down runners and feeding head openings.
50 Core prints not sufficiently definite in some cases to locate cores in proper relative position.

Castings Given Pressure Test

Complicated Work Made Air Tight by Skilfull Method of Gating and Judicious Use of Risers—Down Gate in Center Core of Air-Cooled Cylinder

BY. H. E. DILLER

IN THE general jobbing foundry such a great variety of orders are received that the organization as a whole must be expert in all classes of work and be most thoroughly capable if every job is to be handled in the most expeditious and economical manner. Not only is the variation found between light work and heavy work, cored castings and those without cores; but some castings which according to their shape would require identical molding treatment are limited by differing requirements such as freedom from all defects or the ability to stand pressure tests. The latter must have different treatment in molding and also a quality of metal distinct from castings which do not have to meet such rigid requirements.

In such cases the jobbing foundry either must reject the work or it must form the organization to carry it, equip for it, and arrange to melt a special heat. Furthermore, the metal from the sprue and over iron must be kept separate from the other metal in the shop. For this reason few foundries find it profitable to attempt too wide a range of work. When the Gartland-Haswell-Rentschler interests, consisting of fifteen or more foundries, were joined, it became apparent that it would be profitable to centralize in one foundry the production of the most intricate castings. No sharp line was drawn as to what constituted a complicated job, but the plant of the Platt Iron Works, Dayton, O., was purchased and the Gartland Haswell Rentschler Foundry Co. was formed to produce high grade gray-iron castings. This plant was purchased March, 1920, and the new company went after business just at the start of the recent depression. The foundry is well located being in close proximity to the plants of the Delco Light Co. which makes an air-cooled gasoline motor, electric light and power plants, water systems, a refrigerating system, and other equipment requiring a number of complicated castings, also the works of the General Motors Research Corp., and the Dayton Wright Areoplane Co., which also require many castings which are difficult to make. The officers of the new company are Gordon S. Rentschler, president; M. F. Gartland, vice president; J. C. Haswell, secretary and treasurer, and F. A. Schneider, general manager.

When a few of the castings made in this shop are described together with the molding procedure it will be apparent

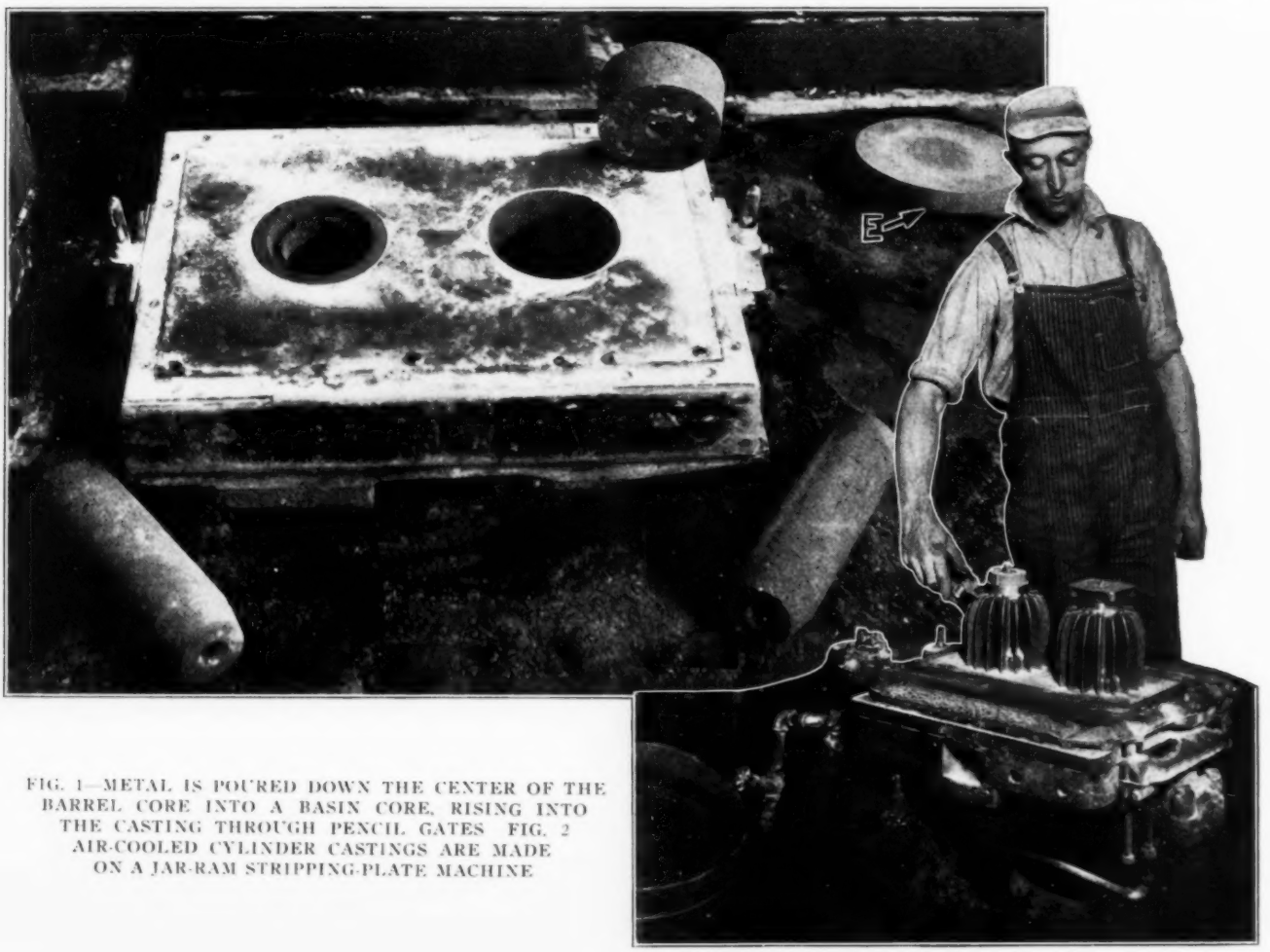


FIG. 1—METAL IS POURED DOWN THE CENTER OF THE BARREL CORE INTO A BASIN CORE, RISING INTO THE CASTING THROUGH PENCIL GATES FIG. 2 AIR-COOLED CYLINDER CASTINGS ARE MADE ON A JAR-RAM STRIPPING-PLATE MACHINE

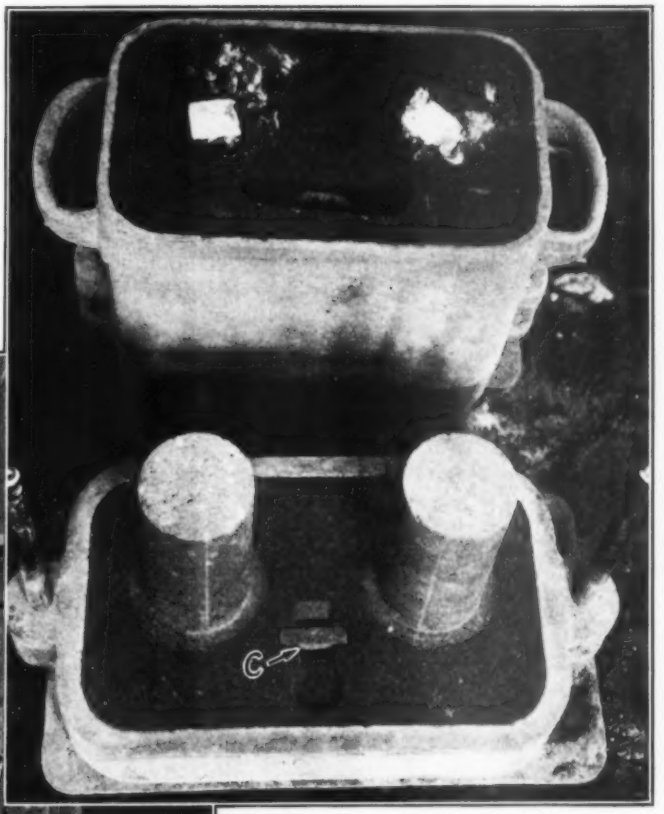


FIG. 3—RIGHT—COPE AND DRAG FOR AN AIR-COOLED CYLINDER—NOTE THE SKIMMING CORE C IN THE RUNNER IN THE DRAG ALSO THE SKIMMING CORE IN THE POURING BASIN

FIG. 4—LEFT—A JAR-RAM MACHINE MAKES THE COPE SHOWN IN THE INSERT

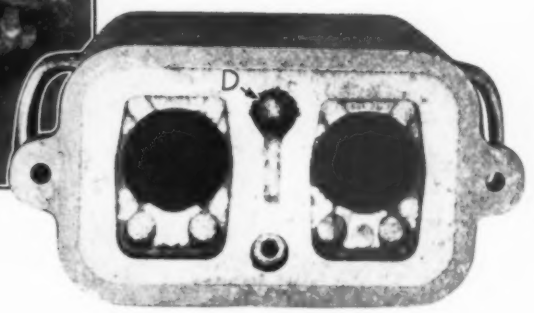


FIG. 5—LEFT—THE CORE PRINTS ARE HELD FIRMLY BY A CLAMP IN THE JAR-RAM MACHINE USED FOR MOLDING THE DRAG—NOTE THE CORE PRINT ABOVE THE PARTING

what a complicated class of work is produced. Of course, the metal, which will be decribed later, has a great influence in the production of sound castings, but the molding methods have an equally strong bearing on the results. Probably the main consideration in making the molds is the method of gating and the precautions taken to strain the metal to prevent slag and dirt inclusions from entering the castings. In the illustrations given, a number of different ways of introducing the metal into the casting are illustrated. These include not only methods of gating, but the placing of risers for feeding the metal as it sets. The latter is considered quite important by the company which insists that thin-walled castings require risers as do those with heavy walls, although the former class of castings are not generally fed in the average foundry.

Cast in Single Units

The first casting which will be described is a cylinder for an air-cooled automobile motor. These are cast in single units and not in blocks of four or six as is the usual practice in water-cooled motors. The requirement which makes them so difficult to produce is that both the inside and outside surface must be machined and a casting will not be accepted unless it shows both surfaces without imperfections. Then too, the fact that both the inside and outside surfaces are machined increases the chances of the casting failing when it is put under the 80-pound hydraulic test which it must withstand. A water-cooled cylinder has the advantage of one wall in the same state in which it is cast to prevent any porosity from extending entirely through the wall, but in this cylinder an appreciable amount of metal is taken off the outside surface to enable copper cooling vanes to be welded on, and any internal shrinks will be fatal to the casting.

THE Gartland, Haswell, Rentschler Foundry Co., described in this article is one of a group of thirteen foundries making light and medium gray iron and semisteel castings of every description, and controlled by the same interests. The others are:

Hamilton Foundry & Machine Co., Hamilton, O.; Gartland-Toledo Foundry Co., Toledo, O.; Gartland-Carroll Foundry Co., Sandusky, O.; Gartland-Haswell Foundry Co., Sidney, O.; Decatur Castings Co., Decatur, Ind.; Marion Grey Iron Foundry Co., Marion, Ind.; Atlas Foundry Co., Marion, Ind.; Gartland Foundry Co., Terre Haute, Ind.; Peru Foundry Co., Peru, Ind.; Kankakee Foundry Co., Kankakee, Ill.; McCarthy Foundry Co., Chicago, Ill.; Gartland-Danville Foundry Co., Danville, Ill.

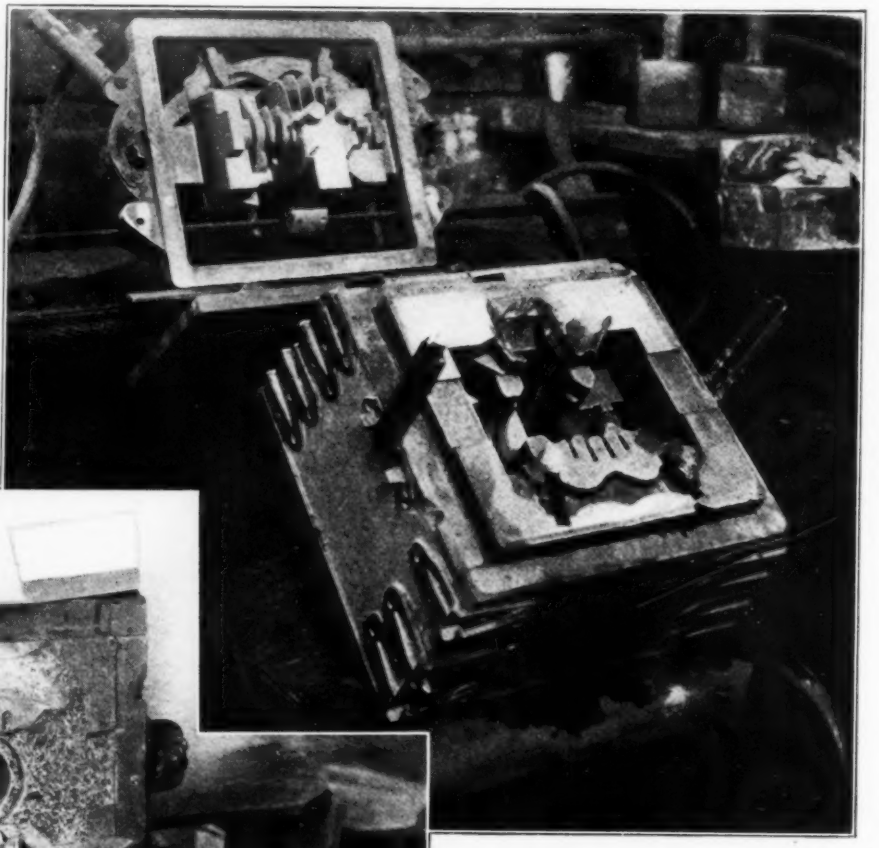
The capacity of the thirteen foundries in the chain is more than 600 tons daily.

William J. Gruss is sales manager for the group, with headquarters at Dayton, O.

As is indicated by Figs. 3, 4 and 5 which show different views of the mold and the machines on which it is made, the casting is a plain cylindrical barrel with footings at one end for bolting it to the crankcase. The drag is made on a hand-ram, rollover machine made by the Osborn Mfg. Co., Cleveland. The first operation is to set the cores in two holes in the pattern plate, the prints remaining above the plate. Fig. 3 shows the machine with one core set. After the molder sets the second core, he pulls together two handles, one of which is shown at *A*, Fig. 3. These close two sliding plates around the cores and hold them securely, centering them and maintaining them in a perpendicular position

Vent Holes Closed

Before putting on the flask, the molder places a large nail in each of the two vent holes in both cores to prevent sand from dropping in and closing the vent. The drag flask, which is 9 x 14 x 3 inches



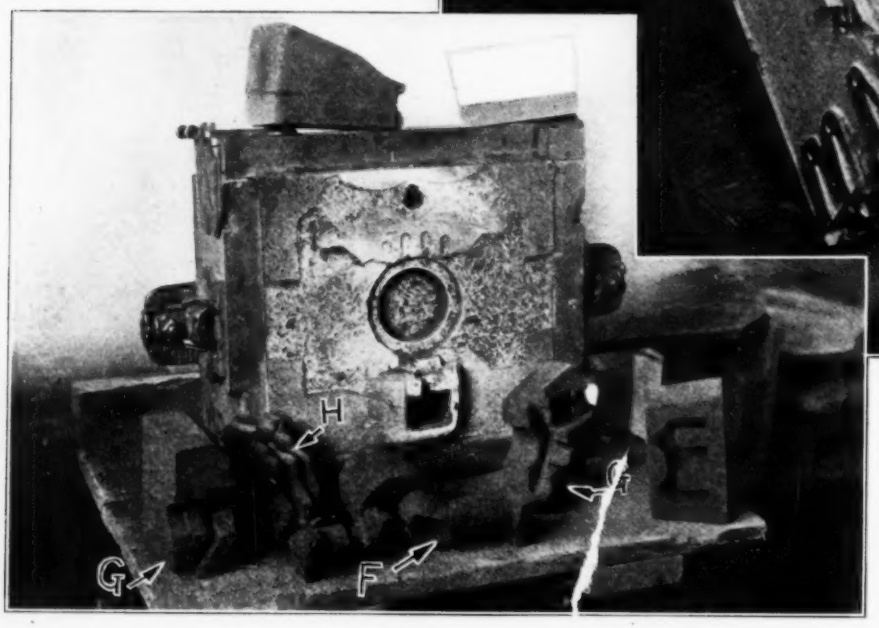


FIG. 6—AT LEFT—COPE AND CORES FOR THE CYLINDER HEAD SHOWN IN FIG. 11—NOTE THE LARGE OPENING FOR THE RISER ON THE LOWER PART OF THE COPE FIG. 7—DRAG AND PATTERN FOR THE CYLINDER HEAD SHOWN IN FIG. 11

FIG. 8—AIR-COOLED CYLINDER

is then put on and the sand sifted in and rammed by hand. When the mold is struck off the nails are drawn from the cores, then the bottom board is put on and the two clamps *B*, *B*, Fig. 5, are pressed over the flask and the whole turned over onto the sliding table of the machine. After the mold is unclamped the table is drawn forward to enable the molder to lift the mold from the machine.

Jolt Draw Machine Used

The cope is made on a jolt-draw machine made by the same company which made the drag equipment. After the molder lifts off a mold he blows the sand from under the plate and lowers it onto the table of the machine. The sand then is cleaned from the plate by compressed air, as is indicated in Fig. 4,

FIG. 11—HEAD FOR CYLINDER

FIG. 9—COPE, DRAG AND PATTERN FOR A PUMP CYLINDER CASTING—NOTE THE CORES ARE BROUGHT TO THE MOLDER IN BOXES FILLED WITH EXCELSIOR TO LESSEN THE RISK OF BREAKAGE

FIG. 10—PUMP CYLINDER CASTING, FROM MOLD SHOWN IN FIG. 9

which gives a view of the machine ready for the 11-inch cope flask. After the stick for the down gate is set in position sand is sifted to make the flask half full, then more sand is shoveled in and the flask jolted. The top of the pattern then is cleared of sand and the basin block and plugs for a small riser on the center of each cylinder are set. Nipples for riser plugs may be noted on the patterns in Fig. 4. The sand then is butt rammed, struck off and vented with a wire. The basin block and riser plugs are removed and a strainer core consisting of a perforated sand disk is set in above the down gate. Cores are placed in recesses made by the riser plugs to prevent dirt from falling into

FIG. 12—CROSS SECTION OF PUMP CYLINDER CASTING SHOWN IN FIG. 10

FIG. 13—THE PATTERN FOR THE DRAG IS MOUNTED ON A ROLLOVER MACHINE FIG. 14—BELOW—COPE AND THE CORES FOR THE DRAG MOLD FOR THE BODY CASTING OF AN ICE MACHINE, SHOWN IN ABOVE INSERT

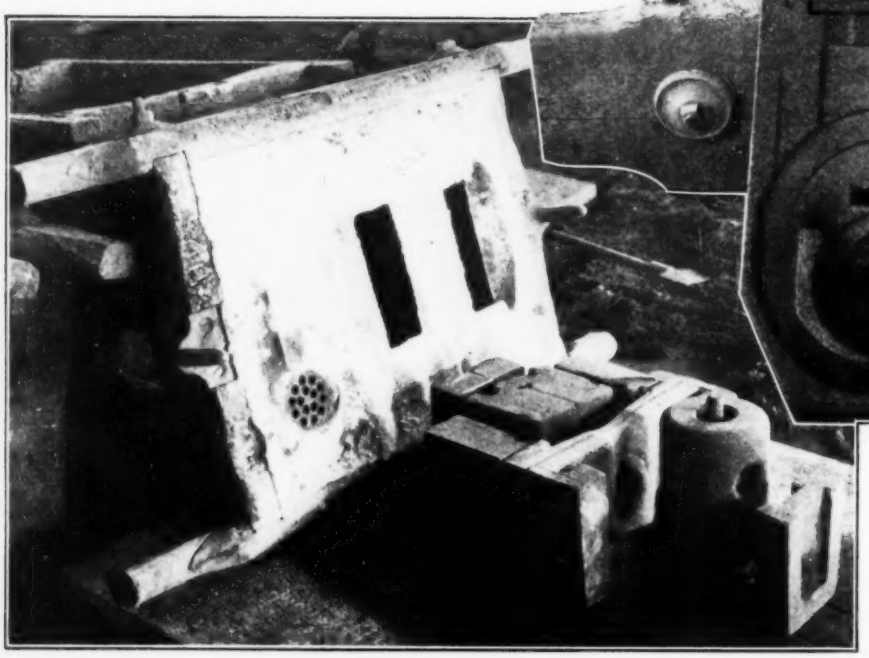


FIG. 15—DRAGS WITH CORES SET—NOTE THE COVER CORE ON THE SECOND MOLD

Specification for Gray-Iron Castings

This specification covers high grade gray iron castings for automotive work.

This company will furnish all necessary patterns and drawings which shall be considered a part of this specification.

In order to meet the chemical and physical properties, specified in paragraphs 4, 5 and 6, an addition of from 5 to 8 per cent Mayari iron and from 10 to 20 per cent steel is required.

The gray iron shall conform to the following requirements as to chemical composition:

	Per cent
Total carbon	3.00-3.50
Manganese	0.20-0.60
Phosphorus, not over	0.30
Sulphur, not over	0.10
*Silicon	2.00-2.75
Chromium	0.10-0.25
Nickel	0.05-0.15

*A silicon content of from 2 to 2.25 per cent is desired on cylinder castings.

American Society for Testing Materials standard arbitration test bars, when placed horizontally upon supports 12 inches apart and tested under a centrally applied load, shall conform to the following requirements:

Load at center, min.	3500 pounds
Deflection at center, min.	0.15 inches

Arbitration test bars shall be furnished by the founder, upon request.

Gray iron castings shall conform to the following requirements as to brinell hardness:

Cylinder castings	200-225
Crankcases and other castings	180-210

The castings shall conform to the dimensions specified on drawing.

Surfaces which are to be machined shall admit of finishing to the required dimensions without leaving any traces of the original surface.

Castings shall be free from cracks, blow holes, or other injurious defects.

the mold, and to retain a slight air pressure in the mold while the casting is being poured. The stripping plate then is raised and the mold carried to the floor and finished after which it is set on the drag.

The insert, Fig. 4, shows the top of a cope which shows the pouring basin and part of the strainer core, also the two plug cores over the risers, whitened to accentuate them in the illustration. The metal fills the basin giving the slag an opportunity to rise to the top. Then as the iron falls into the down gate, it is strained through the strainer core and falls into the basin shown in the drag, Fig. 3. It then flows over a slight rise in the runner and travels under the core *C*, Fig. 3, and up into the runner in the cope and into a skimming basin *D*, indicated in the insert, Fig. 2, in the cope. Here slag or sand from the mold, which has gotten into the iron, has another chance to settle out before the metal enters the casting through a gate cut from the basin *D*.

Other Methods of Gating

A still different method of gating is illustrated by the mold for an air-cooled cylinder for the gasoline engine of a lighting set made by the Delco Light Co. Unlike the air-cooled cylinder previously described, this cylinder has the cooling vanes cast of the same metal as the cylinder, and directly on it. The vanes, together with the footings, necessitate the use of a three-part flask. A view of the cheek pattern, Fig. 2, illustrates the reason for this. The pattern at the right has the loose piece set on while that on the left is in the position in which it is left when the sand is being jolted. This operation packs the sand uniformly between the vanes and then the loose pieces are set on the pattern and sand is tucked under and around them and butt rammed before being struck off.

While the cheek is 7 inches deep, the cope is only 4½ inches high and the drag 4 inches, the flask being 12 x 17 inches. Thus the cope and drag readily can be hand rammed on stripping-plate machines. A view of the drag, Fig. 1, shows the unique method of gating to secure casting which will withstand a hydraulic pressure test of 80 pounds per square inch without leaking. The drag mold itself is simple, consisting of a plain body of sand with two cylindrical holes in which cores are placed. One core is shown in position while the other may be seen resting on the mold. The two body cores which set in the basin cores, are shown in front of the mold. These contain the down gate, metal flowing through the center of the body core passing through the large hole in the center of the basin core into a pocket underneath, then up through the eight pencil gates spaced in a circle in the basin core. From these pencil gates, the metal enters directly into the casting. The cores are brought level with the surface of the mold by pressing them down with the flat-faced circular block *E*, Fig. 1, until the entire circumference of the block rests on the face of the mold. The cope consists of a plain barred flask 4½ inches high containing the impression for the top of the flange and a pouring basin with down gates to the centers of the cores.

The head for this cylinder must withstand the same test of 80 pounds pressure as the cylinder and is even more complicated than that casting, requiring a heavy riser. It is made in a 13-inch square flask on a plain jolt machine with a pattern in a frame as shown in Fig.

FIG. 16—CORES ARE PLACED IN THE OVENS BY THE COREMAKERS WHO BUILD THE RACKS WITH PIPE AS NEEDED

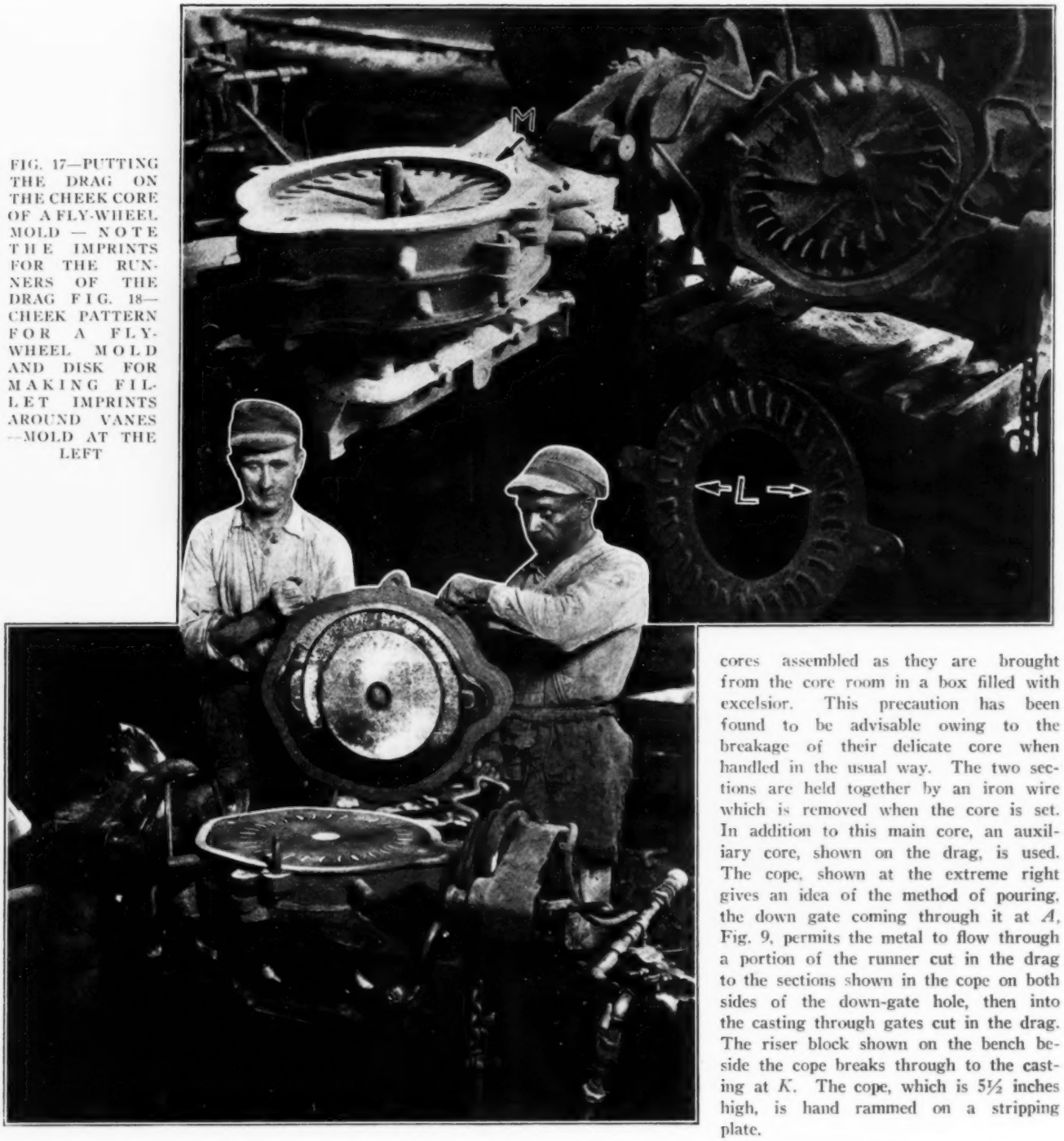


FIG. 17—PUTTING THE DRAG ON THE CHEEK CORE OF A FLY-WHEEL MOLD — NOTE THE IMPRINTS FOR THE RUNNERS OF THE DRAG FIG. 18—CHEEK PATTERN FOR A FLY-WHEEL MOLD AND DISK FOR MAKING FILLET IMPRINTS AROUND VANES —MOLD AT THE LEFT

7. The drag which is shown here is 8 inches deep and the cope, Fig. 6, is 5 inches deep. The latter illustration also shows the cores which are set in the drag. The core *F* forms the combustion chamber and the intake and exhaust ports, and fits into the cores *G*, *G* at each end. The core *H*, forms the spark-plug base and rocker arm together with two of the cooling vanes. This portion of the casting gives the most trouble from leakage under the water test. The core at the extreme right fits into the space in the mold formed by the loose piece shown at the right on top of the flask, Fig. 6. This forms the extension on top as indicated in Fig. 11 which shows the casting. As the side of the loose piece may be seen the riser block which indicates the large size of the riser used to feed the casting although the sections of the casting are light and the casting itself is small.

The pump cylinder, Figs. 10 and 12, is another casting which must withstand a pressure test. The casting shown in Fig. 12, has been cut in two and illustrates the variation in metal thickness in the casting. It also gives an idea of the problem of coreing met in making this casting. The drag is made in a 14-inch square flask, 7 inches high, on a plain jolt machine, as indicated in Fig. 9. This illustration also shows some of the main cores assembled as they are brought from the core room in a box filled with excelsior. This precaution has been found to be advisable owing to the breakage of their delicate core when handled in the usual way. The two sections are held together by an iron wire which is removed when the core is set. In addition to this main core, an auxiliary core, shown on the drag, is used. The cope, shown at the extreme right gives an idea of the method of pouring, the down gate coming through it at *A*, Fig. 9, permits the metal to flow through a portion of the runner cut in the drag to the sections shown in the cope on both sides of the down-gate hole, then into the casting through gates cut in the drag. The riser block shown on the bench beside the cope breaks through to the casting at *K*. The cope, which is 5½ inches high, is hand rammed on a stripping plate.

Holds Sulphur Dioxide

The body casting for a refrigerating machine must withstand an even higher water pressure than the castings just described. This casting must hold sulphur dioxide gas under a pressure of 60 pounds per square inch and therefore is tested under 125 pounds per square inch air pressure when submerged in water to allow a sufficient factor of safety. The same iron is used for pouring this casting as is used for cylinders. The drag which is 15 x 20 inches and 13 inches deep, is made on a power rollover, pattern-draw machine made by Henry E. Pridmore.

Chicago, shown in Fig. 13. As may be noted from the pattern, the cope is simple to make, forming a deep hollow for a number of cores. The cores of which there are 13, are shown in Fig. 14, in front of the cope, arranged relatively in the same position which they occupy in the mold, except that they are bottom up. The core farthest to the right is the end core, and next to it is the round core which forms the chamber for the pump. Back of this is a double core with an opening in the center, the edges of which are formed of chills rammed in the core to close the grain of the metal at this point and prevent the formation of a porous spot. The cores at the back form the gear housing. After these cores are placed carefully in the mold, as shown in Fig. 15, the cover core, standing in front of the mold, is set on. The second mold shows the cover core set. Beginning at the left may be noted the hole for the down gate, an opening for a riser, a vent hole which comes over the center of the chunk core forming the pump chamber, and finally two riser openings. The slab core is held down by a cope, 4½ inches deep, which is held on by *C* clamps. The under side of the cover core is shown in Fig. 15. As indicated here the two riser openings at the end of the cover core are joined into one in the cope. The skin core in the pouring gate may be noted at the left in the cope. The metal flows from this core through a runner in the cope to the round hole shown in the cover core and immediately enters the casting.

Requires Three-Part Mold

Not all of the complicated castings made in this shop must stand the water pressure test; an example of one of the more complicated castings which do not have to stand this test is the flywheel for a ¾-kilowatt motor for a lighting set made by the Delco Light Co. This is made in a three-part flask 18 inches in diameter. The cope and drag are molded on a plain jolt machine and the cheek is formed on a rollover jolt machine. Barred cast-iron flasks are used for the cope and drag, 4½ and 3 inches deep respectively. The cheek flask is 3½ inches deep and forms the blades for circulating the air for cooling the motor. The pattern for the cheek may be seen in Fig. 18, while Fig. 17 shows the cheek rammed and ready for the drag. In the pattern the fillets at the bases of the blades next to the pattern can be formed by the pattern, but on the other end the fillet must be formed in the mold by a metal pattern disk, *L*, Fig. 18, which is pressed down on the face of the cope after it is molded and before the pattern is drawn.

The drag being placed on the cheek, Fig. 17, shows the runners for the metal which is poured in two down gates. The clamping irons for holding the drag on the cheek while being rolled over may be noted on each side of the flask. Holes for the down gates may be noted in Fig. 18, which shows the location of the strainer gate at *M*. This also shows the hub core in position. This is the only core used in the mold other than the two strainer cores. The second strainer core is located in the pouring basin because the wall of sand between the casting and the down gate is too thin at that end of the mold to permit a strainer core in the cheek. The cope is almost identical with the drag, varying only in that it does not carry the runners, but has two down gates.

A precaution taken in the core room to make the individual coremaker entirely responsible for his work is to have the coremakers' benches directly in front of the ovens so that the coremaker can place his cores in the oven as soon as made with no intermediate handling by other workmen.

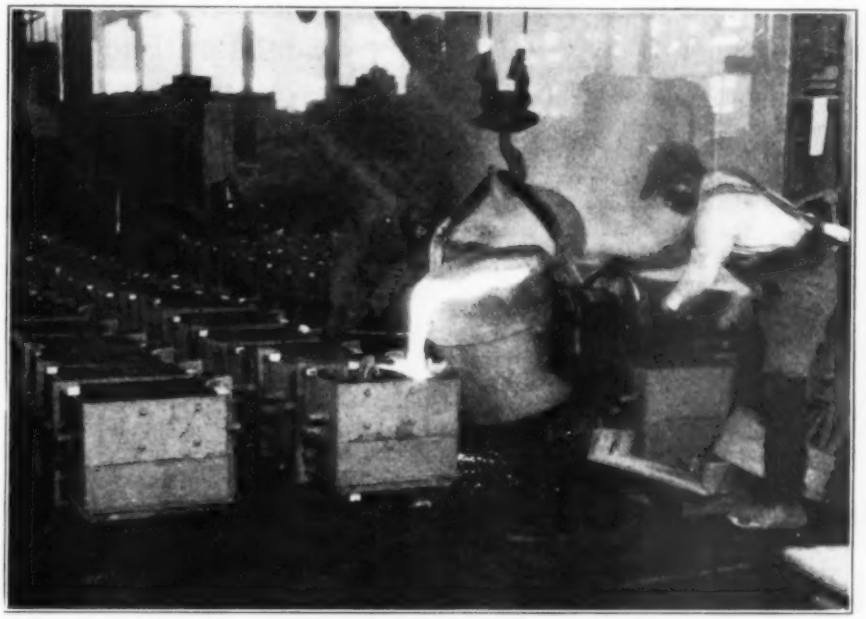


FIG. 19—POURING MOLDS FROM A LADLE CARRIED BY THE ELECTRIC TRAVELING CRANE

In this way no one but the coremaker can be blamed for defects in the core due to handling. The inside of each oven is arranged with racks as shown in Fig. 16. These racks are made by setting 1¼-inch pipe across the oven, resting the ends in slots in bars extending along the sides as indicated in the illustration. The ovens are filled during the day and the cores are baked and removed at night so the ovens are ready for the coremakers when they come the next morning.

Before describing the building and equipment, the third essential to successful operation, the metal, will be discussed. It is melted in two cupolas, the one lined to 36 inches and the other to 48 inches inside diameter. A third cupola, lined to 84 inches inside diameter is available but seldom is used. Three mixtures are standardized and occasionally special mixtures are used to suit special work. In the three regular mixtures, the manganese is kept the same, between 0.50 and 0.60 per cent, also little variation is found in the carbon which averages close to 3.30 per cent in all mixtures. In the soft-iron mixture high silicon, ranging from 3.00 to 3.25 per cent is used to make an iron which will be soft in the smallest castings. The sulphur in this mixture is kept extremely low for cupola iron, not running much higher than 0.06 per cent. In the other two mixtures this element averages close to 0.08 per cent. Phosphorus in the soft-iron mixture is kept between 0.45 and 0.50 per cent. A mixture with lower silicon is used for crankcases and similar work. This contains from 2.25 to 2.50 per cent silicon, and the phosphorus also is slightly lower than for the soft-iron mixture, averaging about 0.4 per cent.

An entirely different mixture from the two just described is used for cylinders and castings which must stand a water-pressure test or are subject to wear. This mixture conforms closely to the specifications of the General Motors Research Corp., shown in the accompanying table. As may be noted, the phosphorus is kept low and the silicon is also lower than is used in the two other mixtures. The Gartland Haswell Rentschler company keeps the silicon as close as possible to the lower limit of 2.00 per cent. As recommended by the specifications 8 per cent of a chromium-nickel bearing pig iron, is used to secure the required amount of these elements. The upper limit of 20 per cent steel has been

found by this foundry to give the most satisfactory results. Arbitration test bars are cast with every heat and little trouble is found in meeting the physical requirements of the specification for transverse test and brinell hardness when requirements of the specifications in composition are fulfilled.

Two large brick structures receiving abundant light through side walls almost entirely made of glass are used by the company for foundry purposes. Only one of these is now operated, the other was the former machine shop of the Platt Iron Works is 200 x 500 feet, giving an available floor space of 100,000 square feet. This will be equipped and operated as a foundry as soon as the first shop is completely filled with work.

The No. 1 plant which was the foundry of the Platt Iron Works, was put in condition for the class of work to be handled. The three cupolas already in the foundry were put in service and iron at present is delivered to the charging platform by an electric traveling crane inside the building. However, a staging is being installed outside the building directly behind the cupola floor and a 20-ton crane taken from the old machine shop has been placed on a runway with a 60-foot span and 125 feet long over the stock yard and covering the staging at the charging floor. Stock then will be handled by the crane with a magnet and grab bucket.

Monorail Carries Metal

The building is divided into two side bays and a central bay covered by a monitor roof. The cupolas and coreroom occupy one side bay and the remainder of the shop is given over to molding, with the exception of an L-shaped extension at the one end which is used for cleaning and shipping. A monorail system has been erected to carry metal to the different floors. This metal is carried in 1000-pound ladles and delivered to hand ladles for pouring into the molds. The larger molds are poured from a 1500-pound ladle carried by one of the overhead cranes operated from a cage on the crane. Fig. 19 shows a row of molds for crankcases for lighting plant engines being poured using the traveling crane.

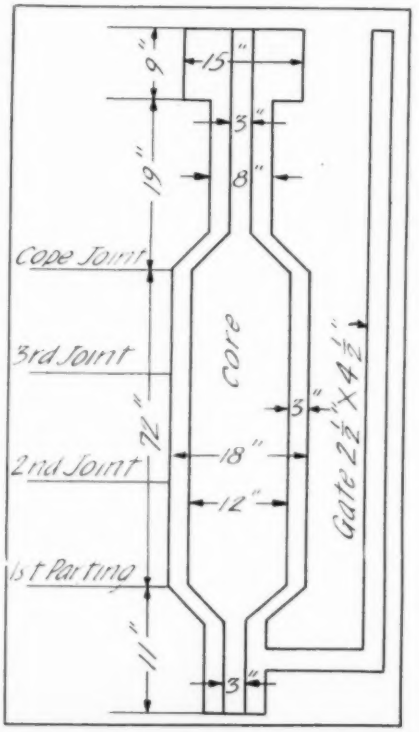
The company is well supplied with cranes having received 18 electric traveling cranes and 26 jib cranes with the buildings. One of 20-ton capacity and another of 10-ton capacity are installed in the main bay of the foundry and three 5-ton cranes are installed in the side bays.

The coreroom is equipped with 9 coke-fired ovens similar to the one described and shown in Fig. 16. Two other coke-fired ovens of the movable rack type are served by a lift truck. Twelve large tumbling barrels, two of which are 54 inches square, all furnished by the W. W. Sly Mfg. Co., Cleveland, are installed in the cleaning room. A sand-blast room with a rotary table also is used to clean the more delicate castings. Four double grinders have been installed for snagging the castings.

One of the changes made by the new company on acquiring the shop was to take out the old stoves and equip the building with five coke-fired heaters made by Robert Gordon, Inc., Chicago. The stoves formerly used became red hot and heated only the immediate vicinity and did not spread the heat. On the other hand, the new heaters are cooled with a blast of air blown by a motor-driven fan which forces the heated air into a wide area around the heater.

Roll Cast in Dry Sand Scabs on Face

Question: We are enclosing sketch of a hollow roll which we make in weights ranging from 4500 to 5300 pounds. Usually we experience no trouble with this casting but occasionally one scabs on the face. Most of the scabs are on the first section above the drag, but they also appear on the upper neck. The scabbed material does not rise to the top of the flowing metal but appears scattered all over the face of the casting. Our facing mixture is made up of 2 parts old sand, 2 parts new sand, 1 part coarse fire sand and 2 buckets of flour, wet with diluted liquid core binder. The blacking is sprayed on the mold and afterward washed with a thin solution of core binding liquid. The core sand is bonded with flour and the ends of the core are bound with wire and slurried with a mixtrue of brass sand and raw core binder. We have noted a rumbling noise all the while the mold is filling with iron, but the core vents freely and after the casting has cooled the core presents no difficulty in cleaning. The blacking is mixed with claywash and a little diluted core binder. The mold is made in an iron flask provided with vent holes. The 4-inch thickness of sand around the pattern is rammed with an air rammer. The runner is made up separately and attached to a flanged pocket in the drag flask.



SECTIONAL VIEW OF ROLL MOLD, CORE AND RUNNER

Answer: The fact that some of your castings scab and others do not would seem to indicate that your practice is not uniform. You state that your facing is made up of 2 parts new sand, 2 parts old sand, 1 part coarse fire sand and 2 buckets flour, but you do not say what quantity of sand is in a *part*. If the part means an ordinary wheelbarrow load the amount of flour is not excessive. The rumbling noise you hear while the mold is filling indicates that the iron is boiling due to gas driven into it either from the mold or the core. Our opinion is that both mold and core are too hard due to the presence of an over dose of core binder. Briefly we should suggest that you cut out the liquid core binder, use a greater proportion of fire sand in your facing mixture, ram a good cinder bed around both necks so that the extra body of sand at those points will dry more rapidly, pour the iron through a smaller gate set at a tangent to give the metal a whirling motion and finally pour the iron as hot as you can get it.

Instead of wrapping the lower end of the core with wire and then daubing it with a slurry made of brass sand and raw liquid core binder, a piece of 3-inch pipe could be slipped over the core to preserve it from the iron stream flowing from the gate. The upper end of the core needs no envelope. Coremakers sometimes overlook the fact that molten metal converts the core binder into a gas and that gas has to escape. An overdose of core binder makes a hard firm core that will hold its shape under all kinds of abuse, but the same core repels the iron violently and sets up a boiling that produces a dirty casting. The ideal dry sand mold or core is one that is just strong enough to withstand the pressure of the metal and one that will readily crumble after it has served its purpose. The binding material should be proportioned in such a manner that the heat of the casting will consume it completely. Where an excess of binder is employed some of it remains unburned and transforms the sand into an almost solid rock, exceedingly difficult to clean out of the casting.

Production of Large Bushings

Pouring from Lower End of Tilted Mold Introduces Metal Quietly—High Pouring Temperature Is Advocated To Produce Sound Castings—Theories Regarding Porosity Are Discussed

BY CHARLES VICKERS

THE shape of cylindrical castings of bronze may vary within wide limits; they may be straight, plain cylinders having the length three or four times the diameter, which is the more common form; or the diameter may be equal to, or surpass the length, and in weight they may vary from a few ounces to hundreds of pounds each. The smaller sizes can be put on pattern plates for machine molding; even bushings three or four inches in diameter, and 12 or more inches long can be plated for machine molding with advantage when used in sufficient quantity. But the larger sizes are generally molded by hand as the number demanded at one time is rarely sufficient to justify the installation of large machines, unless the latter find use for other classes of castings.

While most forms of bushings appear plain and simple to make, perplexing difficulties are not unfrequently encountered in getting perfect castings, not alone with the large sizes, but even in the case of patterns so small that quite a large number can be attached to a single plate for machine molding. Especially is this the case when the castings are required to withstand hydrostatic pressure. In this connection an interesting and unique method of molding small cylindrical pressure castings—a method that proved a positive remedy for the porosity encountered when they were made by the time honored and usual methods of molding and gating—is described with illustrations by William H. Parry in a paper presented before the American Foundrymen's association at the meeting held at Rochester in June, 1922, and reprinted in the Oct. 1 issue of THE FOUNDRY, pages 806 and 807. This paper is worthy the most thoughtful consideration of all brass foundrymen, whether they are called upon to make such castings or not, for the method of molding described, while so much out of the ordinary as to be somewhat startling at first, is based upon sound principles and is not confined to the type of castings illustrated in the paper.

Small Holes In Metal

It is stated by the author that the castings were porous when made by ordinary methods. It may be well to consider the word porosity is not always applied to the same thing. In one case, it may mean the metal was permeable to gases and liquids under pressure, while otherwise the castings appeared sound. In another case it may mean that after the skin of the castings had been cut away by machine tools, small holes appeared in the metal, and were scattered all over the surface of the casting. When such holes are small, ranging from a little larger than a pin head down, they produce a condition known as *porous*, meaning the metal is filled with pores. When the holes are the size of a pea and upward they are called blowholes.

The invisible kind of porosity is not exposed by tooling the castings, but by the application of pressure to a gas or liquid held inside the casting. This type of porosity is due to minute vacancies that exist between the crytsals of the metal, and which communicate, one with the other, forming passages from the interior to the exterior of the casting. These passages are exceedingly small in cross section, and tortuous as they worm their way between the crystals, and their presence is not discovered unless the castings are put under pressures when the contained liquids or gases escape through the thickness of the metal.

Gases Produce Holes

The porosity caused by holes visible on the surfaces after machining are evidently due to the presence of gases in the metal which have been retained as the castings solidified. These gases may have been absorbed during the period the metal was molten in the furnace, or they may have had their source in the mold, which was made too *close*, either by too dense ramming or by unsuitable molding sand, to permit of the free escape of the gases generated from the mold material. In addition to these, causes of this type of porosity there is another; the source of which appears with our present limited understanding to be a loss of the power on the part of the metal to hold gases in solution, which ordinarily are so held. This condition appears to be brought about by a too high or a too low pouring temperature.

Intercrystalline porosity, the invisible kind that requires pressure to detect it, has been thought to be caused by an expansion of the individual crystals of the metal, followed by a contraction during a later period of solidification. The expansion would naturally push each crystal away from its fellow the subsequent contraction would then open up little seams between them, thus creating passages through the metal thickness.

The objection to this theory is that by the time the crystals in the heart of the metal thickness had formed, the skin of the casting adjacent to the cool walls of the mold would be solid and strong enough to resist any expansion of the surface such as would naturally follow expansion of the inner crystals. The result of this would be that the inner expansion, instead of pushing the crystals away from each other, would produce a compressive force that might conceivably distort the crystals. The subsequent contraction would then merely relieve this compressive strain, instead of opening up seams between the crystals. The net result of this crystal expansion and contraction would thus be nil, as far as causing the leakage of the castings was concerned.

Then, changing the method of gating the castings would be without effect on the crystal changes of the metal. It would not be an antidote for leakage to make a change of gates, but experience has shown the method of gating does have a profound effect on the solidity of the castings. We have learned that some methods of introducing the molten metal into the molds will produce castings valueless under pressure, while other methods give castings absolutely dense and sound in this respect. Thus the crystal expansion and contraction theory appears weak in the points enumerated here.

Eutectic Portion Drains

Another explanation of the cause of intercrystalline cavities or seams in metal was advanced by the present writer in the course of an article on gating test bars in the August, 1917, issue of THE FOUNDRY. It is briefly to the effect that such vacancies are due to a drainage of the eutectic portion of the alloy to some lower part of the casting structure, after the formation of the crystalline portion of the metal, and that this drainage leaves behind minute crevices which would be intercommunicating,

since a fluid had passed through on its way to a lower level. Should this be the case it is evident that to obtain a dense structure of metal uniformily filled with crystals and eutectic all that is required is to provide a reservoir of metal that will remain liquid until after the casting has solidified, and thus to enable the latter to draw on this supply as required to fill up vacancies that may be created in the upper parts of the casting as the first limited supply of eutectic drains from crystal to crystal on its way to the lowest vacant points of the casting.

If the leakage under pressures is due to some such explanation as the one advanced here, then changing the gating system to ensure a head of metal in a position to seep down by gravity to every part of the castings would obviate the difficulty. This, it may be observed, is exactly what was done in the case described by Parry, and which solved the problem of producing castings that would hold the pressures under which they were required to work. Also it explains how risers function to build up sound castings, and why chills are valuable.

Applying these considerations to the case of a large, long bushing molded horizontally with one half of the circumference in the drag and the other half in the cope, the best way to ensure that all parts of the casting are fed from an external supply of liquid metal, would be to place the gates on the highest point of the casting, so the metal would be dropped into the mold on top of the core as shown at *A*, Fig. 1. If the mold was set perfectly horizontal, it would be necessary to place drop gates along its entire length, as shown, to get the feeding effect desired. This would necessitate the placing of a long basin on top of the mold in order to supply the down gates, and to provide a reservoir of heat that would ensure the small drop gates being kept fluid while the casting was solidifying. The nearer this reservoir or basin could be put to the casting, the better; therefore, the down gates would have to be short.

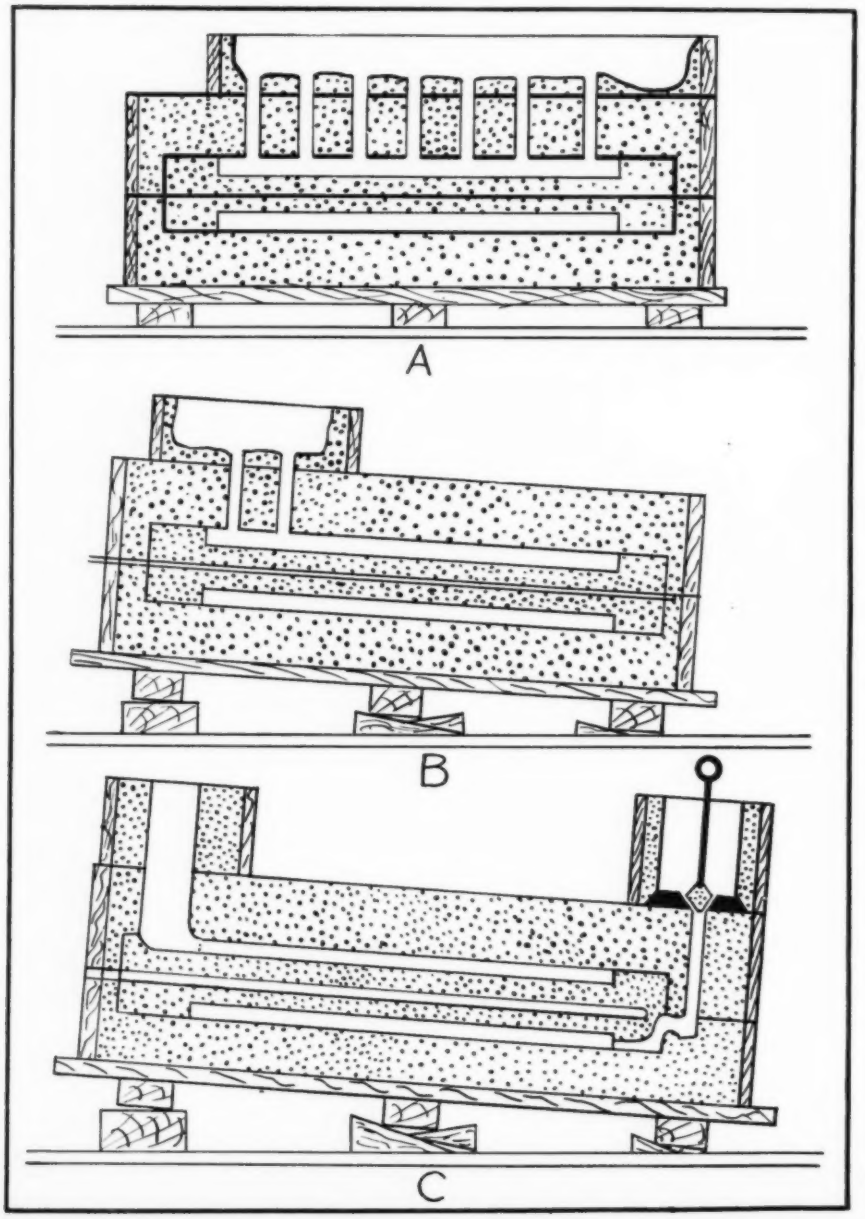


FIG. 1—CORRECT AND WRONG WAYS OF GATING BUSHINGS

Mold Is Tilted

A little consideration of the method *A*, Fig. 1, brings to mind many doubts. In the first place it would require a plentiful supply of molten metal to pour the mold and fill the large basin. Now liquid brass costs money, therefore, it is an economy to keep down the ratio of metal melted to castings produced. This can be done by simply tilting one end of the mold as shown at *B*, Fig. 1, for it is evident the lowest end of the casting would draw liquid, whether eutectic or not, from the portions of its length that were more elevated. In such a case it will be unnecessary to place the down gates the entire length of the casting. They can be confined to the highest end as shown at *B*, Fig. 1. This change materially decreases the amount of liquid metal necessary to feed the casting, so a greatly shortened basin can be used with the result of saving fuel to melt metal.

However, some of the doubts that came to mind about method *A*, Fig. 1, still remain when the change is made to *B*. Thus the liquid metal is being dropped directly on top of a round body of dry sand, the core, and while it may do no harm to the latter, the stream bounds off the rounded surface and is split into droplets which bombard the sides of the mold with considerable force. Of course, it is possible to make the mold strong enough to withstand these blows of the liquid metal, so neither mold nor core are damaged, but air is always present within the mold, and the spattering, flying metal may entrap it. Then when the castings are machined spongy spots will be discovered, rendering the castings valueless.

With some special shapes and thicknesses of bushing castings, as will be shown later, method *B* has to be used, as no other method of gating will run the casting. But in the case of thick and heavy castings, the chance of cutting the mold surface and aerating the metal must be considered.

Spattering Avoided

The plunging down and spattering of the entering metal can be avoided largely by running it in at the joint of the mold instead of using drop gates on top as illustrated at *B*. A better way is shown at *C*, Fig. 1. In this method the metal is flowed in at the

lowest point of the mold, as the latter lies on the incline, with the result that instead of racing down the length of the mold cavity it quickly forms a pool at the gate end. Here the metal gathers and is pushed upward into the mold by the pressure of the metal in the sprue which rises gradually as the metal fills the mold. Thus the fall is shortened and broken and the liquid fills the mold comparatively slowly and without agitation, also no air is carried into the mold by the metal. For these reasons the inclined mold, with sprue and gate at the lower end, can be expected to produce sound, clean castings.

The illustration *C*, Fig. 1, shows the gate cut into the core, or it may be so molded by attaching a pattern to the corebox. It is not particularly important to use this type of gate, and sometimes it is preferred to gate into the side of the casting at the joint. If two sprues are used as shown at *E*, Fig. 2, one at either side of the pattern, gates can be cut into each side of the casting at the joint. With two gates the mold will be filled more quickly and the danger of porosity is lessened. Whether one or two gates are to be used will depend largely upon the diameter of the casting. Long, heavy bushings of small diameter, 8 to 10 inches outside, have been made successfully using the one gate, either as shown at the end under the core, or on the joint. Of the two methods, the gate under the core is to be preferred.

Brass castings of the type being discussed must show free of blemishes when machined. The end gate under the core is helpful in accomplishing this, but several other precautions also must be taken. The most important precaution is to pour the metal at the proper temperature, neither too hot or too cool. This is a vague statement as it stands and later will be amplified.

Adequate Riser Supplied

The precaution next in importance is to have an adequate riser in a good position to feed the shrinkage. A third precaution is to place heads on the mold sufficiently high to create pressure on the metal so that it can force the air and gases out of the mold in a rapid and positive manner. When low heads are used the metal advances in a slow and vacillating manner, and instead of driving the air before it, it may flow around and enclose bubbles with the result that blowholes are formed under the skin of the casting.

The core also may be so vented that the easiest way for the air and gas to escape is through the vents provided for that purpose. The mere fact that a channel is cut through the heart of a core and connecting with an opening through the mold, does not ensure that all the gas formed will pass off that way, for the gas produced by the burning of the core surface may be unable to pass quickly through the core thickness intervening between the core surface and the vent. This gas is given little time to escape so it is essential to devise sure means of getting it immediately away from contact with the liquid metal surfaces.

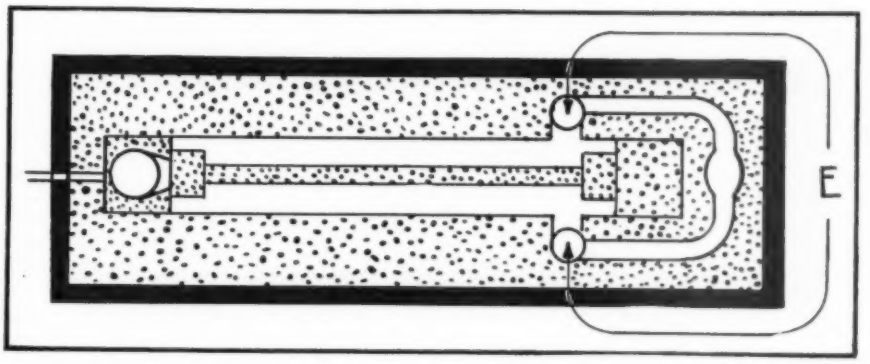


FIG. 2—POURING BY TWO GATES TOPPED BY COMMON BASIN

Whenever a casting, large or small, is found to be spongy in the bore and sound on the outside formed by the mold, it can be concluded the matter to concentrate attention on is the core, and not the method of melting the metal, or ways and means to *deoxidize* it. A thoughtful study of this subject, backed by the practical experience of years has led to the conclusoin that much loss due to porous and spongy castings has its origin in the difficult and tardy escape of the gases generated from cores and mold. It is hoped later to deal more extensively with both these sources of porosity.

The most important precaution to be taken to ensure sound, clean castings is to pour the metal at the *proper* temperature.

Just what is this *proper* pouring temperature? First, it cannot be the same for all shapes of castings; evidently a thick, heavy casting will require less fluid metal than a thin casting of large area. Many cast shapes are made that require the metal to be poured into the mold just as hot as it can be obtained at the mold side. Even then special methods of pouring and more properly dumping, the metal have to be practiced, otherwise, the castings will be misrun. But with the massive casting, no matter what it may weigh, filling the mold cavity is a foregone conclusion even with metal barely liquid. Such castings can be poured several hundred degrees cooler, than the exceedingly thin castings.

The term *hot metal* so frequently used means nothing; also it means nothing to the great majority of brassfounders to give pouring temperatures in so many degrees Fahr., or Cent., as measured by pyrometer, because the latter instrument lacks universal use. It would undoubtedly be a wonderful aid to the nonferrous casting industry if a cheap rugged, dependable temperature measuring instrument could be permanently attached to each melting unit, and another one be quickly applied to the metal at the mold side. It is desirable to have two pyrometers, one at the furnace and another at the mold, because atmospheric conditions are never uniform from day to day. This causes the temperature fall of the metal during the time of transference from furnace to mold to vary from day to day, a fact now well known to large producers of aluminum castings, who take into consideration each morning just before pouring commences, the state of the weather outside the shop, the temperature, the wind velocity, etc., and adjust the metal temperature in the furnaces, according to tables compiled by themselves. Even after this has been carried out, the first heat is considered an experimental one, the castings being subjected to careful scrutiny before any more pouring is done. Should misruns be noted, the metal temperature in the furnace is raised, should porous spots or cracks be in evidence the temperature is lowered.

Has Wider Spread

The pouring temperature for brass and bronze has a wider spread than that for aluminum alloys. Castings are said to be poured *jumping hot, hot, cool,* or *dull.* The latter condition there is no mistaking, the metal looks dull and sluggish and it strings from the lip of the pouring vessel. The only castings that should be poured with such metal are ingots, and not even such, if they are to be sold.

Cool metal will not string from the lip of the ladle like dull metal. Some foundrymen believe this to be the best pouring temperature for the larger castings, and as a consequence have more than their rightful share of troubles with blowholes, porosity and shrinkage. As before remarked, the conception of what is *hot* metal differs materially. In one case where heavy losses had been taken due to porosity in bushings, such as are being discussed, the instructions given

were to raise the heads, and pour hot. This was supposed to be done, but still the first casting made under the new conditions was far from perfect, though it was thought it *might pass*. The heads were of correct height, and the casting was poured *hot*, it was stoutly maintained by the foundry foreman. But no one's word was taken for the temperature of the metal on pouring the second casting, and it turned out that all previous castings had ben poured decidedly cool.

When really hot metal was used there were no more porous castings. The term *hot* used here means a bright orange for such an alloy as 88-10-2; and for 85, three fives, or ounce metal. It means the zinc smoke will break away freely from the surface of the metal, and it will appear bright, and will not *ice* over readily if it has to stand a few moments. Some molders appear to be afraid of bright appearing liquid brass, they figure it will destroy their molds. If it does, the molds have not been properly made, or the sand is utterly unsuited for the purpose.

Molds Hold Hottest Steel

Brass or bronze at temperature hot enough for the thinnest castings is cool compared to liquid steel, ready for the mold, and molds are made every day to hold the hottest liquid steel without scabbing or blowing. Therefore, there is no question about being able to make molds that will withstand the pouring of any alloy of copper, even though it may be "hot enough to run needles," as the expression runs. All alloys are not *hot* at the same temperature, as they do not all contain the same quantity of low melting white metals. Thus yellow brass, and such alloys as half lead and half copper would be hot at around the solidification point of 88-10-2 alloy, which is about 1800 degrees Fahr. But the alloy known as ounce metal, containing 15 per cent of white metals, will have to be handled at the molds at close to the same temperatures as the 88-10-2 alloy, for although it contains 3 per cent more white metal, 10 per cent of its white metal content consists of zinc and lead which have a higher melting point than the 10 per cent of tin in the 88-10-2 alloy. This difference in melting temperature offsets the 3 per cent extra amount of white metal. Ounce metal will look hotter than 88-10-2 when at the same temperature because of the breaking away of the blue zinc flare, and many are deceived thereby into pouring it too cool to get sound castings.

The pouring temperature of 88-10-2 alloy, as we learn from the researches of Carpenter and Elam* is at its best at 2192 degrees Fahr., practically 2200 degrees. At 2012 degrees it carries about 212 degrees superheat, coming under the classification *cool*, and the castings are often unsound, it was found during this investigation. To pour at this temperature, then, is to take chances. The castings may be good, then again they may not. It is not good business to speculate in this manner. In the case of heavy castings, or castings of massive section, a pouring temperature of 2100 degrees Fahr. is the lower limit and has given satisfactory results. This temperature carries 300 degrees superheat. When this alloy is poured at 2552 degrees Fahr., according to the authors of the paper, the castings are certain to be unsound. Obviously this finding is not meant to apply to castings so thin it would be necessary to use this temperature to get them to run fully.

The alloy known as ounce metal—copper 85 per cent, and tin, zinc and lead, each 5 per cent—is frequently used for large and heavy castings. Frequently such castings are found to be unsound after being machined, though in the case of small castings no such difficulty is ever seen. In the event of such an experience, the next castings should be poured with hotter metal, and care should be taken to make certain that it really is hotter. Should doubts about the mold arise, it should be made in dry sand and coated with a wash of good plumbago before drying.

When castings must be particularly free of blemishes the first metal dropped into the pouring basin should be prevented from running into the mold cavity carrying along with it any dross that might float unseen on the surface of the liquid metal. One way of ensuring against this mishap is to place a basin over the top of the sprue, the design of which is copied from the lavatory wash basin. It is merely a sand basin fitted with a hole in the bottom which lines with the sprue, and is tapered, narrowing downward to enable a plug to be fitted in it. This basin is first filled with metal, then the plug is lifted, pouring being continued meanwhile at such a rate that the basin is kept filled all the time the mold is taking metal. Any dross floats on the surface of the metal in the basin and stays there.

In the case of bronze castings which are expected to be perfectly clean as a rule, it is advisable to mold the basin on top of the cope before the mold is opened to remove the pattern and finish. It is usual to use one or more small iron flasks for the basin, the bottom of which is made with a flat slab core carrying one or more tapered holes, according to the number of sprues that are used. These slab cores are bonded with silicate of soda and are strong as stone. They are shaped off to fit the small iron flasks used for the basin, and rest firmly on the small retaining ledge of the flask. These flasks are placed in position, the slab core being put in so the hole lines with the sprue pin through the cope. It is necessary to bed the core on to the sand of the cope. This is done the same as for a bottom board, after which the basin is rammed with sand. It is a good idea to use sharp sand bonded with silicate of soda for the basin and ram it around a pattern, and before lifting it off the cope, to swab it with plumbago wash, then run it into the core oven so it will be dry and warm when wanted. The plug can also be made of sand, but when a number of such castings are made it pays to make a permanent plug of cast iron formed smooth and conical to fit the hole in the core. The wrought iron lifting loop can be cast in or threaded into the finished plug. A number of these plugs should be on hand. The part of the plug that will be covered with the molten metal, also the stem, should be protected by a previous painting with linsed oil, and while wet, sprinkled with dry sharp sand which will adhere strongly after baking in the core oven. Pouring heads of this type are useful for large castings of manganese bronze and aid materially in getting clean, sound castings.

Report Progress in Sand Investigation

R. A. Bull, chairman of the joint sand research committee working under the American Foundrymen's association and the National Research council, reports highly satisfactory work completed developing methods of testing sands. A number of tests have been conditionally approved by the subcommittee on tests and by the executive committee. It is believed that these will receive consideration in time to be reported formally by the joint committee at the American Foundrymen's association convention in Cleveland. The methods of testing have had practically a year's trial. They include those for determining bond strength or cohesiveness, permeability and fineness, supplementary tests covering the determination of die absorption and for making chemical analyses. A method of sampling has been conditionally approved and probably will be announced at the Cleveland convention.

The committee has received an unsolicited contribution of $1000 from the American Foundry Equipment Co., New York, for its molding sand research fund. Two research engineers now are employed and another soon will be engaged. These engineers supplement the part-time work of the 24 subcommittee members and of the other investigators not listed in the joint committee who have collaborated at many foundries and in the laboratories at the bureau of standards.

Cornell University and the University of Illinois.

The activities of the joint committee have been chiefly directed toward developing standardized tests necessary to the selection and comparison of all sands. However, subcommittees on conservation, reclamation and geological surveys have been active and will soon report.

The joint sand research committee numbers 48 members and its personnel includes 10 metallurgists and physicists of high standing, six each of foundrymen engaged in steel, malleable, and gray iron casting manufacture, five nonferrous foundrymen, five geologists, six sand producers and six refractory and ceramic experts. The American Society for Testing Materials is represented by three men on the committee, while four representatives of the bureau of standards, one from the bureau of mines and one from the Canadian department of mines have rendered valuable scientific service.

How and Why in Brass Founding

By Charles Vickers

Aluminum Metal Suitable for Matchplates

Will you please indicate a mixture of aluminum suitable for making match plates?

Regular No. 12 aluminum alloy is used freely for pattern plates. This alloy, when made from new metals, consists of aluminum 92 per cent, and copper 8 per cent. It is generally made conveniently by adding the copper in the shape of a hardener, the latter consisting of 50 per cent copper and 50 per cent aluminum. The aluminum and the hardener are melted together in the proportion of 84 per cent aluminum and 16 per cent hardener. The hardener can be made in the foundry, or it can be purchased in prepared form from advertisers in THE FOUNDRY. Some makers of match plates add a little tin, approximately 2 per cent, to the alloy to facilitate machinability.

Melts Under Temperature of Boiling Water

Please supply a formula for a cheap, low-fusing metal that we can use to fill holes in hard wood. The alloy must not burn the wood. In some instances we desire to join two pieces together by pouring the metal around a lag screw suspended in a hole bored in the two pieces.

Alloys of low fusing point never are cheap and in this instance an alloy like Woods metal is required. The formula for this alloy follows:

LOW FUSING POINT ALLOY

	Per cent
Bismuth	38.75
Lead	30.75
Cadmium	15.25
Tin	15.25

This alloy melts at 160 degrees Fahr., and should be poured at a little under the temperature of boiling water. It will not char the wood and will fill the holes tightly. Instead of attaching two pieces of wood by pouring metal around a lag screw, a better way would be to dig a recess extending from one piece of wood to the other with the sides of the recess corrugated like the screw. Make a cement by boiling fine sawdust to a pulp, then squeezing out the water and mixing with a good glue. Bed the lag screw in this paste until the recess is filled to within ⅛-inch of the top, then squeeze on the paste a piece of wood cut to neatly fit the recess. Allow the joint to dry under pressure and if the covering piece is properly fitted the joint will be difficult to discover.

Purple Alloy Formula for College Campus

We are confronted with a rather unique casting problem in that we have to make metal signs in gold and purple for a college campus. We can imitate the gold color with brass, but we are unable to produce a mixture of a decided purple color. Can you give us a formula for a purple alloy.

Outside the precious metals, in this case out of the question, we know of only one purple alloy. It is a full purple color but is quite brittle although hard and permanent. We believe it can be used in this instance by making the castings heavy and setting them in the sign so they will be backed by a stronger metal. We are unable to state positively, but are inclined to the opinion that the alloy can be soldered. When chill cast it is quite strong and with a little ingenuity it can be set in place in the sign, then polished to bring out the full purple color. The alloy is made as follows:

PURPLE ALLOY

Copper	50 per cent
Antimony	50 per cent

To produce a stronger metal the antimony can be decreased 2 or 3 per cent and the copper content correspondingly inceased without injury to the color. A red metal will produce a richer gold color than a yellow brass for your signs.

Cast Aluminum Rollers

We cast small aluminum rollers, 2¾ inches long and 1⅝ inches in diameter. We have used 50 per cent aluminum ingot and 50 per cent aluminum scrap, such as crankcase scrap. We poured the aluminum at what we considered the right temperature, and gated the rollers heavily, but on turning them in the lathe, we find pin holes over their entire length, which appear to go right through the castings. We have fractured one of the rollers and compared it with a fractured section of crankcase aluminum, and the metal in the crankcase appears a much finer grain, and when turned the chip resembles steel turnings. No holes are found in the crankcases. What can we do to eliminate these holes?

Usually the temperature at which the aluminum is poured into the molds has an important bearing on the soundness of the castings. If poured hot, there will be holes, and in the case of these rollers the aluminum should be silvery when molten, and not red in color. Pour as cool as it can be used and fill up the molds. The superior grain of the crankcase metal is due to its containing more alloy than the metal being poured into the rolls. The addition of 50 per cent new ingot, cuts the alloy in half, and if the original metal in the crankcases contained 8 per cent copper, with small amounts of iron, and possibly zinc, as is usual, there will be in the metal used for the rolls, only half this alloy.

If an alloy first made is of copper 50 per cent, aluminum 50 per cent, and then ingoted, and the charge for the rolls is made 50 per cent crankcase metal, 42 per cent of the ingot aluminum, and 8 per cent of the 50-50 hardener, all melted together, a much better aluminum alloy for the rolls will result. Pour this alloy as cool as possible and just before removing it from the furnace flux it with a small piece of zinc chloride, about a teaspoonful, followed by stirring to bring up oxides, then better results will be obtained.

Bill Has a Word on Cupola Practice-II

BY PAT DWYER

DISTANCE, time and the natural aversion of the average man to letter writing in any form, serve to enstrange people from the friends of their youth. However, the sentiment connected with old times never dies and if there is any more agreeable experience than meeting again the friends of these bygone days, after a lapse of many years, I have yet to learn it. Eugene Field hits the idea so perfectly in one of his poems that I am minded to repeat one of the verses:

There are no boys like the good old boys,
When we were boys together.
When the grass was sweet to the bare brown feet
That dimpled the laughing heather.
When the pee-wee sang to the summer dawn
Of the bee in the billowy clover;
Or down by the hill, the whip-poor-will
Echoed his night song over.

I had a letter the other day from a boyhood chum whom I have not seen since I left the old home town a quarter of a century ago. Among other things he intimated that he expected to attend the A. F. A. convention in Cleveland, April 28-May 3 and looked forward to helping me rake up the ashes of many a forgotten camp fire.

The allusion was particularly happy and flashed on memory's screen hundreds of events and incidents of those far off days when we were boys together. At that time we lived about 10 miles from the ocean in a small town built on both sides of a respectable sized river where the rolling tides rose and fell twice in every 24 hours. The edge of the primeval forest was within easy walking distance in almost every direction and we were as familiar with the geography of the surrounding country as we were with every street and alley in the town. Judged by modern standards I am afraid we were a band of young barbarians to whom a home only represented a place in which to eat and sleep and a school was a form of penal institution maintained by a cruel and heartless ruling power that interfered to a disheartening extent with life liberty and the pursuit of happiness. All our time in the afternoon, on Saturday and during the long, lazy summer vacation was spent either in the river or the woods. Shoes and stockings were tolerated on occasion as a badge of servitude, but cheerfully and even enthusiastically were shed with nearly every other garment when we launched a venerable dugout canoe on the river.

We discovered this relic of a dead and gone pioneer on one of our exploring trips and for several blissful summers, armed with barrel stave paddles, we toiled and sweated and drove the unwieldly old craft in a manner which we fondly imagined would have done justice to one of the late Fennimore Cooper's long line of fire-eating warriors with tomahawk, wampum, war cry and feathers.

On several occasions we hoisted the Jolly Roger and rigged the well known leg-o'-mutton sail of Robinson Crusoe and the Barbary Rovers, but we never mastered the proper technique of trimming the sail when the captain in ringing tones bellowed the order to *go about*. Invariably, as we attempted this delicate maneuver, the long boat turned turtle and spilled the entire crew into the raging waters. While one weary mariner perched precariously on the bottom of the boat, waved his apology of a shirt and eagerly scanned the horizon for succor, the remainder of the gang grasped the gunn'ls and manfully kicked the water logged wreck through the combing breakers and eventually beached her on the smooth and shelving silver beach of the lagoon.

In addition to scanning the horizon for a sail, the lookout kept a wary eye on the immediate vicinity to warn the swimmers of a black, triangular, dorsal fin swiftly cutting the water in their wake. Safely arrived ashore, a hurried examination was held by the surgeon to determine if every member of the crew still retained his full complement of arms and legs. Satisfied on this point, a council of war usually decided in favor of careening the old tub, emptying the water and re-launching her.

Instances, I believe, are on record where some fastidious parents objected to our mild and innocent forms of pleasure, on the ground, forsooth, that we were in imminent danger of drowning. Looking back on these days from my present parental viewpoint, I can realize some of the anxiety we occasioned, but as a matter of fact we were in just as much danger of drowning as so many young frogs.

The first crisp winds of the fall, the early night frosts and the steadily lowering temperature, drove us reluctantly from the river into the glorious peace, quiet and shelter of the big woods. We had camps on the ground built of spruce boughs; others high up in the swaying branches of tall trees and before the first heavy snow storm of winter arrived on icy wings from the Arctic, we had a snug log cabin erected, calculated to keep us warm and comfortable until the time arrived in the spring when a wild, driving southwest wind and rain storm broke up the river ice and sent it whirling

THERE ARE NO BOYS LIKE THE GOOD OLD BOYS

SAFETY CODE FOR FOUNDRY WORKERS

(*Continued from Data Sheet No. 474*)

Rule 208. *Slings*—All slings used to suspend flasks from jib crane beams shall either be so designed that there are safe clearances for a hand grip, or handles shall be provided to hold the sling.

Section 21. FINISHING AND CLEANING

Rule 210. *How Cleaned*—Where castings are cleaned or chipped in molding or casting rooms, there should be provided suitable screens, partitions or other effective means to protect employes against flying chips and excessive dust. All castings shall, where practical, be cleaned or chipped in rooms separated from rooms used for other purposes.

Rule 211. *Finishing Rails or Benches*—Where finishing rails or benches are used they must be sufficiently far apart to allow the operators to pass between them without being endangered by falling castings.

Rule 212. *Dry Tumbling Mills*—In new installations where dry tumbling mills are used within a foundry, exhaust apparatus shall be installed and operated that will effectively draw off the dust created by the operation of such mills; in existing installations such mills may be enclosed in reasonably dust-tight compartments while in operation. Tumbling mills, when not enclosed, shall be provided with substantial guards on open sides when in operation.

Rule 213. *Dry Grinding, Buffing or Polishing Machines*—Where dry grinding, buffing or polishing machines are used, an exhaust apparatus or its equivalent that will effectively remove the dust created by the operation of such machines shall be installed and operated. This rule shall not apply to floor or bench stands used specially for tool grinding nor to portable grinders.

Rule 214. *Swing Frame Grinding Machines*—Where swing frame grinding, buffing or polishing machines are used, screens shall be provided when necessary to protect adjacent workmen.

Rule 215. *Sand Blasting*—Sand blasting by hand-operated apparatus shall be carried

(*Continued on Data Sheet No. 476*)

SAFETY CODE FOR FOUNDRY WORKERS

(*Continued from Data Sheet No. 475*)

on in suitable sand blast room or outside the foundry, and in both cases effective means shall be provided to protect passers-by from the sand blast. Dust shall not be exhausted into the open air but into a collector.

Rule 216. *Arc Welding*—A guard or shield shall be provided where necessary to protect other workers from exposure to the radiation from the electric arc, and no employe shall be required to work in such a position that his face is exposed to such radiation from any neighboring source.

It is recommended that permanent inclosures be supplied, where practical, for arc welding and cutting.

PART III—LIGHTING, HEATING AND VENTILATION

Section 30. LIGHTING

Rule 300. *Lighting*—The light in every foundry shall be in accordance with the requirements of the Factory Lighting code.

Section 31. HEATING

Rule 310. *Working Temperature*—A comfortable working temperature shall be maintained during working hours in all sections where employes are regularly working.

Rule 311. *Salamanders*—Salamanders shall not be used except where it is clearly impractical to use some other form of heating device. Where salamanders are used, the coke must not have a sulphur content exceeding 1 per cent.

Section 32. VENTILATION

Rule 320. *General Requirements*—The ventilation and ventilating equipment shall be in accordance with the requirements of the Safety Code for Ventilation.

Rule 321. *Removing Smoke, Fumes, etc.*—Where the natural circulation of air is not sufficient to remove smoke, gas fumes or dust injurious to the health of employes, mechanical ventilating apparatus of sufficient capacity to do so shall be installed and operated.

Note.—Factory Lighting Code No. 17 may be obtained from the Engineering Standards committee, 29 West Thirty-ninth street, New York.

(*Continued on Data Sheet No. 477*)

THE FOUNDRY DATA SHEET, MAY 1, 1923
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

and grinding out into the open sea.

It is many a long day since the gang tramped furtively in single file along the secret trail and many a long mile now lies between me and the site of the little old log cabin, but in fancy I am back there again tonight, one of a care free, happy band, a living exponent of the old injunctions: "Sufficient to the day is the evil thereoff," and, "Let the morrow take care of itself."

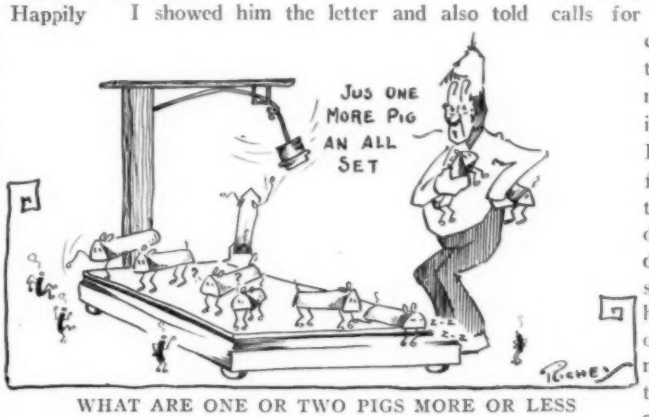
Lying or sitting on the long, wide seat that encircled the room, toasting our shins at a little beehive stove—er—abstracted—from the local foundry scrap pile, we dreamed the long, long dreams of youth and speculated idly on what the future held in store. Happily we were unconscious of the many sharp knocks and bitter experiences that befall the average man even before he attains middle life. The old gang long since has disintegrated and the individual members have been scattered to the four winds of heaven. Only one or two remain consistent residents of the town in which they were born and in which in all probability they will die and be buried in a quiet cemetery that lies on the slope of a sunny hill beside the river.

Two of the mildest mannered little boys, not really active members of the gang, but tolerated occasionally in deference to their older brothers, grew up and then met tragic deaths in the awful days between 1914 and 1918. One went down with the hospital ship LLANDOVERRY CASTLE when she was torpedoed off the coast of Ireland, in haughty and contemptuous defiance of all rules of modern warfare. The other lies under an alien sky in an unmarked grave somewhere in a foreign land, far from home and kindred. There he sleeps his last long sleep in the calm, peaceful bosom of old mother earth under the chaste, white lilies of France, or may be the blood red poppies on the shell swept and crimson fields of Flanders.

Bill came in while I was ruminating along these lines and professed to be deeply concerned over what he was pleased to describe as my solemn and hangdog expression.

"You look," he said, "as if the boss had just sent the office boy to inform you that you were a frost and that your immediate resignation would be accepted with pleasure and three rousing cheers. Snap out of it me lad, snap out of it. Let me see your tongue, or better still, let me feel your pulse or your pocketbook and I'll tell you whether you are more greatly in need of a square meal, a dose of epsom salts or a breath of fresh air to blow the cobwebs out of your mind."

I showed him the letter and also told him of the train of thought occasioned by its reception. He admitted that the subject was interesting, but claimed that brooding over the past served no useful purpose.



WHAT ARE ONE OR TWO PIGS MORE OR LESS

"Let the dead past bury its dead," quoth he. "This little world is rolling along all the time and if you want to stay in the procession you will have to look ahead and not behind. One of the greatest drawbacks to industrial progress, or for that matter to any kind of progress, is the almost universal tendency of people either to stand pat or to moon over the past. For example, consider some of the antiquated features in connection with cupola practice.

"Hot iron is essential to the production of clean castings and I would be the last person to counsel or recommend a reduction of the coke ratio at the expense of cold iron. However, after the requisite quantity of coke to produce satisfactory iron has been determined, it surely is reprehensible practice to use more. Any person who cares to investigate the problem personally will find that, in the great majority of cases, more coke is used than is necessary. When I say, investigate the problem personally, I mean, stand on the stage during the charging period and actually see what is going on. Nicely printed forms, neatly filled in and duly checked off and then laid on the superintendent's desk, do not always represent actual operating conditions. If the form calls for 12 forkfulls of coke between charges and the cupola tender throws in 15, he is not going to mark 15 on the form and thus invite a reprimand. Not he. He marks down 12 and comforts himself with the reflection that what the superintendent does not know will never do him any harm. The unjust steward in the gospel narrative had no monopoly on the process of making friends of the mammon of iniquity. "On the basis that if a small lemon is sour, a large lemon should be sourer, many furnace tenders figure that if a small quantity of coke will make the iron hot, a few additional forkfulls will make it hotter and, of course, for some classes of castings the iron cannot be too hot. The net result of increasing the quantity of coke up to a certain point is that the iron comes no hotter, but it gradually comes slower. Iron melts at a definite height above the tuyeres and when an excess amount of coke is used, that extra amount has to burn away before the iron arrives at the melting zone.

"Many furnace tenders never would draw a prize either for personal neatness or for the tidy appearance of their charging floor and yet these same men usually are seized with an uncontrollable desire to tidy up after the last charge is in the cupola. To that end they

RECOMMENDED BY THE BOARD OF HEALTH AS A REMEDY FOR WARPED VISION FRIENDS

gather all the remaining scrap and coke on the floor and pitch it in on top of the last charge, just to get it out of the way. In fact I have known foremen who instructed their charging men to do this. They calculate the amount of iron required in a haphazard manner and they figure that this extra iron at the close of the heat will serve as a kind of insurance. If it is left over they comfort themselves with the reflection that it can be poured in the pig bed and can be used again.

"They overlook the fact that each time iron is melted it loses approximately 0.25 per cent of its silicon content and that iron, at least in America, is graded by its silicon content and charged for accordingly. Perfectly good scrap that only would require an addition of 40 per cent pig iron in its original state, will require at least a 60 per cent additional after it has been poured in a pig bed and returned in the shape of pig iron to the charging floor. Again, iron costs money to melt and if it is not turned into a merchantable commodity after it is melted, the money expended for melting it is wasted. Three or four extra forkfulls of coke on each charge and a dozen or more at the end of the heat may amount to more than the melter's wages in the course of a long heat.

"The manner in which the iron charges are made up and placed in the cupola, in many instances, may be classed in the same category of carelessness. The foreman issues a general list of instructions to the charging gang concerning the amount of iron to go in each charge and then leaves the matter to the discretion of the men who make them up. I don't think any person familiar with foundry conditions will claim that the men usually employed in that capacity are overendowed either with intelligence or initiative. If they were they would not be in the charging gang. However, no person can deny that they are endowed with what is recognized as a universal human antipathy to doing any more work than absolutely is necessary.

"The established manner of making up the charges in many foundries is to load the material in the stockyard and at some convenient point between the stock pile and the elevator to weigh the loads. Theoretically each load is supposed to weigh a definite amount so that one or more loads will constitute a charge of the cupola. Men accustomed to the work can approximate the amount closely, but others can not. They are instructed to examine the load on the scale and if necessary trim it to suit requirements.

"If some person in authority is standing by the scale this work will be done. The workman will throw one or two pigs off if the scale registers too heavy, or he will place a few additional pieces of pig iron or scrap on the load if it is too light. If left to his own devices he will do neither. Mike, Steve or Angelo will push the load as far as the scale and then drop it with a sigh of relief. He is not interested in whether it tips the beam or not. The only feature about the scale that appeals to him is the fact that it affords him a chance to rest his hands and feet. He throws a wary look around and if the coast is clear, no officious busybody butting in, with orders to add or subtract from the load, he spits on his hands, picks up the load and continues his journey—cheerfully. The material is dumped on the floor or left on the truck, depending on the charging methods in vogue and later is thrown into the cupola. It readily is apparent that in many cases the amount checked off on the charging sheet does not really represent the actual amount that goes into the furnace.

"Some person in authority should impress on these men the importance and necessity of making the charges up exactly to schedule and, more important still, should make it his business to visit the stage, the scale and the stockyard frequently to see that his orders are carried out literally.

"The objection may be advanced that the foregoing is far fetched, and possibly due to a perverted imagination seeking trouble where no trouble exists. The contention will be made that nearly all men are honest, willing to exchange a fair day's work for a fair day's pay. Of course they are, but it is well to bear in mind that the man behind the wheelbarrow has a different point of view to the men behind the desk. Any person who has done actual manual labor, not through choice or for exercise, but from strict necessity for the sake of the emolument involved, will remember how cheerfully he welcomed the starting whistle in the morning, with what zest he tried to do a little more than any other man on the job and how regretfully he dropped his barrow and tore himself away at night. I am confident that if I were to call for a show of hands from those with tender memories of that character, it would be no trouble to count them."

"If you called for a show of hands," I said, "from those who have heard enough of cupola talk for one night, you would have no trouble in counting two of mine."

"Very good, me hearty," said Bill. "Since the feeling seems to be unanimous, let us drop the bottom and call it a day."

French Firm Publishes English Catalog

Molding machines of various types and other pieces of foundry equipment made by Ph. Bonvillain and E. Ronceray at their plant Choisy-Le-Roy, (Seine) near Paris, are described and illustrated in a booklet of 56 pages 8½ x 9½ inches issued by the Universal System of Machine Molding and Machinery Co., Ltd., 97 Queen Victoria Street, London, England. Attention is directed to the fact that in addition to the hand power and hydraulic molding machines operated on the squeezing principle, the company recently has developed and placed on the market hydraulic and electric jolt ramming machines, plain or combined jolt and squeeze, with or without pattern drawing device, standard or rollover type. In connection with the machines the company has developed simplified methods for preparing patterns, pattern plates and striping plates, exterior and interior altogether in the foundry. It is claimed that all the fitting may be done independently of the machine shop.

One page is devoted to explaining the merits of hydraulic power as applied in the foundry. It is claimed that it does not cost as much as any other form of power either for installation or for upkeep. For example the company claims that it is working 17 machines of various sizes in its Paris foundry from a 5-horsepower motor. The machines are designed to work at a pressure of 750 pounds per square inch, but where conditions warrant a pressure of 1000 to 1500 pounds may be secured. The company makes the pumps and accumulators.

Other pieces of equipment described and illustrated include several types of sand mixing devices, core-making machines, core ovens, a pig iron breaker, cupolas and ladles and in fact practically everything required to start a foundry or to keep it in operation.

Establish Branch Office

The W. W. Sly Mfg. Co., Cleveland, has established district sales offices in Chicago and Detroit in addition to the ones already established in other cities. The Chicago office is in the Fisher building, 343 South Dearborn street, and C. P. Guion, district sales manager, is in charge. M. T. Mortensen is head of the Detroit office which is located in the General Motors building. Both Mr. Guion and Mr. Mortensen have been connected with the Sly company and have worked in their respective territories for years.

Core Room Premium System

Methods Adopted by an Engine and Pump Manufacturing Plant To Operate Its Core Room on an Equally Efficient Basis with the Other Departments of the Foundry

BY HERBERT FARR

IN MANY cases, especially in the jobbing shop the core room is the most neglected department. The coreroom in the foundry of the Domestic Engine & Pump Co., Shippensburg, Pa., formed no exception to the general rule before an effort was made to reorganize the department and place it on the same plane of efficient operation as the molding room, cleaning room and pattern shop.

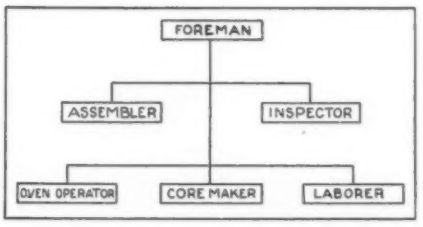


FIG. 1—FUNCTIONAL ORGANIZATION CHART COMPILED FROM THE DATA ON PRELIMINARY TIME STUDIES

The company manufactures approximately 100 different units ranging from small, hand operated farm pumps to power driven pumps in many sizes, diaphragm, centrifugal and plunger types. In addition to pumps, portable air compressors, contractor's hoists also are manufactured in a number of sizes and prime movers for these pieces of equipment are supplied in the form of gas and gasoline engines rated from 1½ to 26 horsepower. Considering the great variety of finished product it readily will be seen that the foundry approaches a jobbing shop in character. For this reason the coreroom could not be designed, arranged and operated on a specialty production basis.

Table I

Preliminary Time Study

Date, Nov. 7.
Workman, Reed.

Operations	From	Time to	Elapsed
Helped pull out car	7:30	7:35	0.083
Removed cores from car	7:35	9:45	2.166
Went to toilet	9:45	9:55	0.166
Removed plates from car and collected materials for making cores	9:55	10:10	0.417
Made cores	10:10	2:55	3.750
Helped with car	2:55	3:05	0.167
Went to foundry to help pour	3:05	4:30	1.417
Total			8.166

The coreroom building, 40 x 60 feet, of steel construction and with a continuous window forming the west wall, is situated parallel and adjacent to the molding department. Vitiated air escapes through three ventilators located on the hip of the roof, one at each end and one in the center.

A battery of six ovens, two car type, 12 x 12 feet inside and four drawer type ovens made by the Whiting Corp., Harvey, Ill., make up the greater part of the east wall. The aggregate available baking space in all the ovens amounts to 454 cubic feet. All ovens are under fired with coal. Hoods are provided over the drawer type ovens to remove fumes from the coal gas and other disagreeable gases caused by oxidation of the core binders. The car type ovens are only operated at night and are not provided with hoods.

A central indicating pyrometer with a multiple point rotary switch supplied by the Brown Instrument Co., Philadelphia, assists the oven tender in maintaining a definite temperature, depending on the weight of the cores.

From a study of the general layout of the building shown in Fig. 2, it will be noted that the raw materials are stored on the west side of the building and flow steadily toward the east. Core sand batches are made up in a mechanical mixer of the revolving paddle type made by the Blystone Mfg. Co., Cambridge Springs, Pa. From the mixer the sand is conveyed to the hopper on the coremaker's bench. The green cores are placed on a receiving bench by the coremaker and taken from there to the oven by a man delegated for the purpose. After they are dried they are taken in hand by the inspector and assemblers

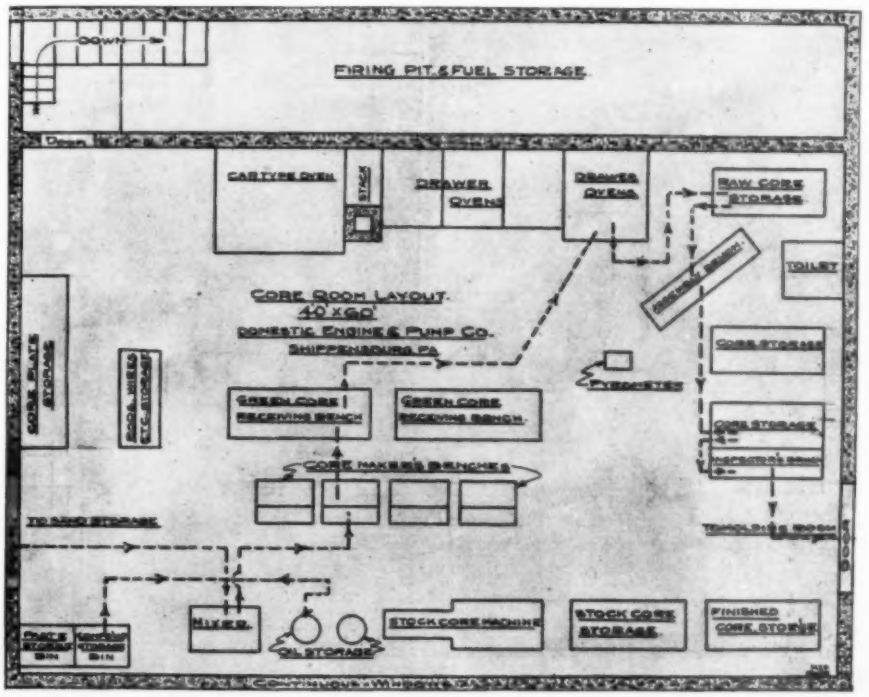


FIG. 2—GENERAL LAYOUT OF BUILDING—HEAVY DOTTED LINE INDICATES THE PATH OF THE CORE FROM THE SAND BIN TO THE MOLDING FLOOR

PATT. NO. 2902-B DESCRIPTION Cylinder Head - 2 H.P. Eng.
P.O. B-3010 DATE 1-22-23 OPERATOR Reed OBSERVER Stout
OPERATION Core WORK STA 230 AT 4.35 P.P. 5.45 C'K'D. H.A.F.
Water Jacket - 1 Req'd.

OPR. NO	DETAILED OPERATION	CONT'D TIME	INDIV. TIME	CONT'D TIME	INDIV. TIME	CONT'D TIME	INDIV. TIME	CONT'D TIME	INDIV. TIME	CONT'D TIME	INDIV. TIME	AVERAGE TIME
1	Put box together	97	97	82	82	82	82	89	89	120	120	85
2	Fill rack with fingers & butt off	137	50	120	48	127	45	171	50	162	42	48
3	Strick off with straight edge	145	08	132	08	141	04	175	04	168	06	04
4	Strick off with trowel	157	12	156	18	161	10	187	12	179	09	13
5	Remove loose pieces	211	54	196	40	190	34	227	50	229	42	50
6	Put in Hook rod	248	37	245	35	248	23	274	37	260	31	34
7	Place plate and roll over box	268	14	289	14	277	14	288	14	272	12	14
8	Put wires in around sp. plug lug	302	40	255	26	259	32	320	32	297	25	32
9	Strick off with trowel	318	16	271	16	276	11	296	16	310	13	16
10	Vent each part twice	328	10	294	18	290	10	306	10	319	09	10
11	Rap box with mallet	346	18	292	12	296	15	360	18	334	15	15
12	Draw off top of box	359	13	301	09	321	26	379	19	356	22	18
13	Draw off center of box	381	22	328	27	348	27	401	22	377	21	25
14	Draw off outside of box	402	11	343	15	363	15	413	12	391	17	15
15	Draw spark plug lug	420	18	364	21	382	19	440	27	422	28	27
16	Patch & finish core	428	08	371	07	390	08	442	20	438	16	08
17	Set finished core on bench	453	25	392	21	415	25	447	25	462	24	25
18			4.53		3.92		4.15		4.15		4.62	4.35
19												
20	Plate 8½" diam. capacity 1											
21	Aluminum core box & loose pieces											
22	Weight of core 3#											
23	1 wire req'd for operation #29 as shown.											
24												
25	Location of box Plate 1 Box #212											
26												
27												
28												
29	TOTALS											

FIG. 3—FINAL TIME STUDY FROM WHICH DATA FOR THE CORE SHOP TRAVELER IS OBTAINED—THE RECORDS ARE FOLDED ALONG THE HEAVY BLACK LINE NEAR THE CENTER OF THE SHEET

and placed in the proper storage racks. Each coremaker works at an individual bench which prevents all interference on the part of other workmen. The bench is provided with all the necessary supplies and equipment, rods, clamps, molding core and parting sand, coke breeze, etc., and therefore each bench may be regarded as a self contained unit where the coremaker is relieved of all work not strictly pertaining to his job of making cores. All the other work including mixing sand and carrying plates is attended to by less expensive labor. Coreboxes are numbered and stored in a building provided for the purpose. They are card indexed according to shelf and aisle number and easily are located when required.

The foregoing account will convey a general idea of the layout and operation of the coreroom. The following description covers the methods employed in the reorganization and the establishment of certain standards.

Formerly the employes of the coreroom were paid a straight hourly rate. Piece work rates had prevailed for years in the other departments of the foundry, but although the coreroom men at different times had requested to be paid in this manner, the management had considered the request impracticable. Finally the management decided to give the 100 per cent premium system a trial. A time study man was detailed to do some preliminary work on which to construct a system. An example of one of these studies is shown in the accompanying Table I. They were taken over a period of one week and covered the activities of each man. After they were completed operations were classified as shown in Table II. A functional organization chart Fig. 1 outlining the specific duties of each workman was prepared based on the data contained in the foregoing tables.

After the chart was outlined general instruction cards similar to that shown in Table III were made indicating the exact duty of each man. In addition they were held by the foundry superintendent with other data as job specifications for replacing men.

Detailed time studies all were made from one man detailed for the particular job. During the period he was under observation he was granted a little increase over his regular rate, partly as an incentive to full effort and partly as an appreciation for his full co-operation. Due care was observed in selecting a man for the purpose because it was considered highly desirable to take the studies from a

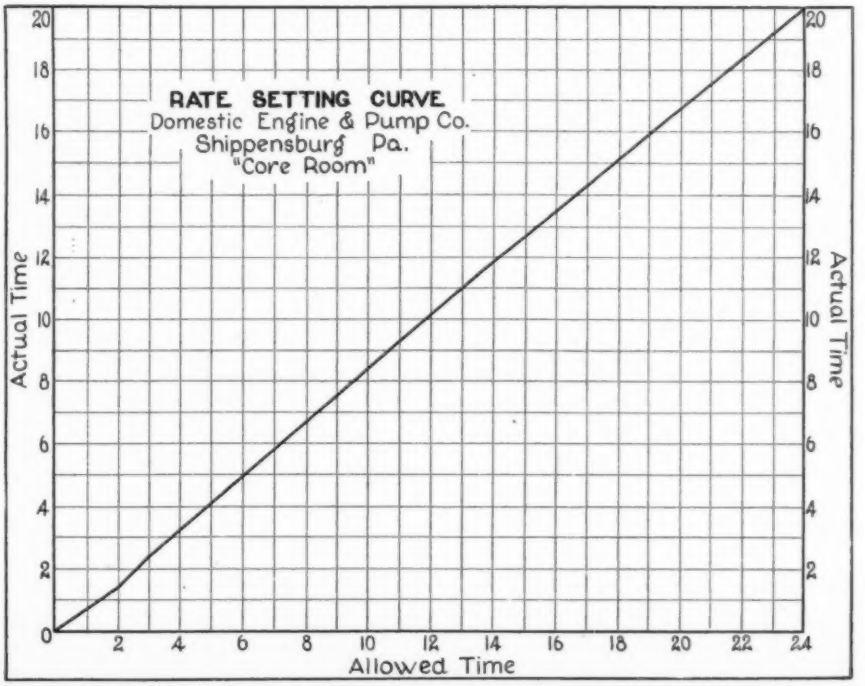


FIG. 4—ALL RATES ARE SET FROM THIS CURVE AND A CHANGE NEVER IS MADE UNTIL AFTER A THOROUGH INVESTIGATION

man interested in the project from a technical viewpoint. These studies were no different from other studies except that they did not include any development work in the form of recommendations. We felt that the time to go more into detail on the work would be after a basis or foundation had been laid. However, the time study man was instructed to point out unnecessary operations and false motions and to eliminate them from his final time. In other words he was instructed to see that his final average time was correct. One of the final time-study cards is shown in Fig. 3.

Based on the time studies, rates were established by the curve shown in Fig. 4. Exceptions or adjustments never were made in the allowed time until after thorough examination. Time once set for a job was guaranteed to remain unchanged so long as the core was made under the conditions obtaining when the time was set. Men were encouraged to suggest new and better methods and generous rewards were granted those whose suggestions were adopted.

Core Shop Traveler

Information relative to the production of cores for a particular job is entered on a form known as the core shop traveler shown in Fig. 5. The traveler accompanies the time ticket or order and immediately after its receipt by the coreroom foreman, he begins to plan his work according to the date specified on the core shop memorandum.

The memorandum filled out not later than 12 o'clock noon by the molding foreman specifies the time the core should be ready, and the items in the various columns indicate the pattern number, number of cores required, the number of the floor to which the cores are to be delivered, and the approximate time of delivery. With this information for a guide the coreroom foreman always knows that the right core is made at the right time. Cores are delivered to the molding floors at the time specified and are checked off the memorandum sheet in a column provided for that purpose.

On the specimen time ticket shown in Fig. 6 attention is directed to the space allotted for the operation number. This space is provided for the convenience of both the time and cost clerks and eliminates a considerable amount of duplicate clerical work. The time clerk enters the operation time items on his daily production record and for obvious reasons it is necessary that the entries correspond with the numbers on the traveler and time ticket.

From experience gained in this case it is apparent that a few necessary precautions must be taken in installing a premium system. Accurate time standards must be established and the only medium for securing these standards is the stop watch. A little educational work may be required in the beginning, because even in this year 1923 there are men who view a stop watch with disfavor and suspicion. However, a little honest effort usually will convince even these skeptical ones of the true value of the watch. In fact the foundry seems to offer a particularly inviting field for time study and scientific management. Definite laws govern the production of a casting and these laws can be applied in the foundry as readily as they have been in the machine shop.

The 100 per cent premium system

CORE SHOP TRAVELER

PATT. NO. 2902-B DESCRIPTION Cylinder Head, 2HP Eng. P.O. B-2406

LOCATION OF CORE BOX. AISLE NO. I BIN NO. 318 DRWN. 306

Oper. No.	NAME OF CORE	No. Req'd	Lower Pcs.	Box Material	Sand Req'd	MISC. MATERIALS REQ'D	Date Time	CORE PLATES Body	CORE PLATES Size	Allowed Time
1	Cover	1		W	10#		D	1	12x15"	1 70
2	Jacket	1	5	Al	3#	2-wires 3½" long.	D	1	7½"ϕ	5 20
3	Intake Valve	1		Al	0.4#	1-wire 4½" long-	D	1	Dryer	1 25
						1-wire 2½" long-				
4	Disc. Valve	1		Al	0.5#	1-8d special Nail	D	1	Dryer	1 50
5	Compression	1	1	Al	2#		D	1	4"x6"	90
6	Jacket Bottom	1		Al	3#		D	3	12"x16"	75
7	Assembly									4 50

FIG. 5—A CORE SHOP TRAVELER ACCOMPANIES THE TIME TICKETS FOR THE INFORMATION OF THE CORE ROOM FOREMAN THE TRAVELER IS MADE OF CARDBOARD 5 X 8 INCHES AND PLACED IN A CELLULOID CARRIER

Table II

Time Study

Operations	Time consumed man hours
Removing cores from oven car	3.920
Mixing sand	2.033
Carrying plates	3.250
Delays and Miscellaneous—time	0.550
Firing ovens	1.667
Making stock cores	1,580
Tending ovens	5.500
Pasting, filing, assembling cores	5.000
Making cores	22.000
Supervision	6.500
Total	52.000

10,000-M 12-4-22

Direct Labor Time Ticket J.O. No. B-2406

Symbol No.	NAME	Quantity This Lot	MATERIAL	Oper. No.
2902-B	Cylndr Head 2HP Eng	100	Water Jacket Core	2

TO START DAY	TO START HOUR	TO START A.or P.	WORK STATION SECTION	WORK STATION NUMBER	TO FOLLOW JOB NUMBER	NEXT OPERATION	NEXT WK. STAT. SECTION	NEXT WK. STAT. NUMBER
15	7:30	A M	C	030	3927	3		

Defective Casting		Inspector's Initial	Allowed Time	TIME RECORD
Def. Purchase Part		Remark's	5.20 Min.	F.
Def. Equipment			DATE	S.
Workman's Error			1-31-23	F.
				S.

CLOCK NUMBER	ALLOW'D TIME	ACTUAL TIME	PIECES FIN.	PIECES O. K.	PIECES DEF.	PAY FOR	QUANT. REM.	WAGE RATE	TOTAL WAGE
	S	E	T	-	U	P			

FIG. 6—A TIME TICKET FROM THE GENERAL OFFICE ACCOMPANIES THE TRAVELER

PATT. NO. 2902-B PREMIUM RECORD OPER'N NO. 2

DESCRIPTION Cylinder Head - 2HP Eng. NAME OF CORE 5.20 Water Jacket

DATE 1923	MAN'S NAME	NO.	Pcs. Made	TIME Allowed	TIME Actual	GAIN	DATE	MAN'S NAME	NO.	Pcs. Made	TIME Allowed	TIME Actual	GAIN
1-24	Alleman	102	50	260	212	48							
2-14	Sheaffer	74	19	99	140	-41							
2-15	Reed	180	25	130	63	67							
2-16	Reed	120	25	130	58	72							

FIG. 7—ACTUAL PERFORMANCE OF A MAN ON A JOB IS RECORDED ON A 5 X 8 CARD EXCESSIVE OR UNDER EARNINGS EASILY ARE CHECKED IF THE RECORD IS KEPT ACCURATELY

cannot be installed by the by guess and by gosh method so characteristic of many piece work systems. The house must be in order and the standards must be right. If the foregoing precautions are observed and if the men have faith in the justice and integrity of the management the system will work to the advantage of both parties. Three distinct advantages presented by the 100 per cent premium system may be listed as follows:

1. It is based on time, which unlike the dollar, always remains constant. A mans compensation readily may be raised or lowered simply by changing his hourly rate. Under ordinary piece rate conditions it is necessary to change the price on each piece, difficult task when the pieces run into thousands.

2. It is fair both to employer and employes in that a workman may be compensated for loyalty or length of service.

3. It is simple in operation. Men easily may calculate the amount of their earnings.

Accurate and legible records must be kept because petty complaints will be filed from time to time and will have it be ironed out.

The premium record shown in Fig. 7 is self explanatory and will be found useful in many ways. For example if a complaint is received that the price on a certain job has been set too close. If the job has been made at a former time this record may be produced from the files to show how other men handled the same job. If the record shows that time has been saved on the former occasions the foreman can take the card and instruct the workman on the improved methods. The foreman should be instructed that under no conditions is he to leave the man until the latter thoroughly understands every feature in connection with the problem. Half instruction frequently is worse than none.

The premium record also indicates the progress each man is making and should be consulted at periodic intervals to make wage adjustments based on the efficiency of the workmen. Other things being equal, a man who saves an average of two hours a day is worth more to the firm than the man who only saves 30 minutes.

Table III

General Instruction Card

Position: Foreman. Department: Core room.

1. Receive and route all orders for cores.
2. See that all core boxes and all necessary rods, wires, etc., are supplied to the coremaker before releasing an order ticket.
3. See that each coremaker has an ample supply of sand, coke breeze, molding sand, etc., at all times.
4. Bear in mind always *Coremakers are hired to make cores, nothing more, nothing less.*
5. See that the shop is thoroughly cleaned each day.
6. In case of breakdown or delay report immediately to the foreman just above you in rank.
7. See that an ample supply of stock cores are always in the bins.
8. You are responsible for the delivery of cores to the molding room. After the molding foreman tells you where, when, and how many—Get them there!
9. Co-operate closely with the inspector and assembler.
10. Keep plenty of work ahead of the coremakers and in their sight.
11. Make the core room efficient—you are responsible.

Steel Castings Make New Bookings Record

Commercial steel castings booked in March made new high records, according to reports received by the bureau of census and the Steel Founders' society from companies making over two-thirds of the country's steel castings. The March total was 30 per cent greater than March, 1920, the previous high record, both railroad specialties and miscellaneous making new records.

Total bookings in March were 143,564 tons, or at the rate of 148.2 per cent of capacity, as against February bookings at 93 per cent of capacity. Bookings of railroad specialties amounted to 76,409 tons, or almost 200 per cent of capacity, as against 104 per cent for February. Miscellaneous castings amounted to 67,155 tons, or 114.6 per cent of capacity, as against 85.8 per cent for February.

The following table shows the bookings of commercial steel castings for the past nine months by 65 individual companies.

1922	Net tons	Per cent of capacity
July	66,166	68.3
August	63,416	65.4
September	97,919	101.1
October	75,709	78.1
November	60,899	62.8
December	68,889	71.1
1923		
January	*100,605	103.8
February	90,152	93.0
March	143,564	148.2

*Revised.

Takes Charge in Chicago

Jerome E. Sweet, for the past four years eastern district manager of the American Foundry Equipment Co., with headquarters in Boston, will take care of the Chicago territory for that company.

Lets Foundry Contract

The General Electric Co. of Schenectady, N. Y., has just let a contract for a large addition to its steel foundry at Everett, Mass. Plans call for 200 tons of structural steel.

Back to Former Position

Robert F. Eissler, for the past two years assistant to the vice president, Chicago Pneumatic Tool Co., being desirous of doing more active sales work, assumed his former position as district manager at Pittsburgh, April 1. William C. Straub has been appointed district manager at New York to succeed Mr. Gatch, promoted.

Strong Iron Made Without Steel

Selected Brands of Pig Iron with Addition of a Large Percentage of Returned Scrap to the Mixture Give Strength to the Resultant Casting— Malleable Replaces Steel

BY G. A. DRYSDALE

IT IS the prevalent idea among foundrymen that to comply with specifications calling for iron with high physical properties in castings, such as the tensile strength, transverse strength, and deflection, it is necessary to use steel scrap in varying proportions. However, the use of steel scrap is not essential for making castings with high physical properties, as their object well can be attained by the use of suitable pig irons in the cupola mixture and carrying large percentages of cast iron or return scrap. In the first place, the foundryman or chemist who calculates the mixtures for the cupola and tests out the product for chemical and physical properties must realize that different brands of pig iron of approximately the same chemical composition, when used in the same proportions in the cupola mixture, produce castings of different physical properties. The writer does not assume to offer conclusive explanation of the cause other than that possibly the ores used in producing the pig iron control to a great degree the weakness or strength of the iron. Certain brands of pig iron referred to as weak or strong. The author has gone carefully into this matter covering a period of years and with the use of over 30 brands of pig iron, and has obtained some interesting results an example of which is given in Table I. All pig iron used was coke iron and the price of the stronger irons was not appreciably higher than that of the weaker irons.

The assertion is often made that "all irons are good irons when you know how to use them." There is no doubt of the truth of this statement, but for that reason the fundamental knowledge of the difference in the nature of the various pig irons, aside from chemical analysis, is essential in order to have complete control. In other words, the foundryman whose product is gas-engine cylinders, pistons, etc., governed by specifications calling for high physical properties, will select an altogether different brand of pig iron than the foundryman whose product is stove plate, radiators, etc., where the physical properties are not so high, but where fluidity, etc., are of major importance.

The comparative figures shown in Table II demonstrate the high physical properties which can be obtained without the use of steel scrap, by using strong pig iron, and carrying a large percentage of return scrap. The figures in this table were obtained from records of gray-iron test bar reports, and are the average covering 30 heats from two foundries controlled by one company, but where the two foundrymen had different ideas as to the use of steel scrap.

During the years 1915 to 1917 the Midwest Engine Co. had four mixtures, namely, *Regular*, *Auto*, *No.* 240 and *Diesel*, covered by the following minimum specifications:

	Tensile strength, Pounds per square inch	Transverse strength, Pounds per square inch	Deflection Inches
Regular	23,000	2300	0.100
Auto	28,000	2800	0.120
"240"	30,000	3000	0.150
Diesel	36,000	3600	0.150

We complied with all of these specifications except the latter, by using certain pig irons in definite proportions, and carrying definite percentages of return scrap. In the latter case, we used 15 to 25 per cent of malleable scrap. I have recalled instances where we ran out of malleable scrap and substituted wrought iron scrap in smaller proportions. But we always evaded the latter if possible, in order to retain our high average of uniformity in both our castings and test bars.

When complying with specifications covering castings calling for extraordinarily high physical properties, such as tensile strength of 40,000 pounds per square inch or over, transverse strength of 4000 pounds or over with a deflection of 0.175 inches or over, it is essential to lower the percentage of silicon and total carbon in the cupola mixture so that the castings may contain higher combined carbon content. The method best known at the present time for lowering the total carbon is by the cupola mixture carrying either large percentages of return scrap, steel scrap, malleable and steel scrap, or malleable scrap alone. Steel scrap, as is here shown, is only one of a number of means to this end. Great care has to be exercised in controlling any such iron, for the reason that when in the molten state and poured into molds, it is more susceptible to physical changes than when the silicon and total carbon are in higher proportions. The temperature at the time of pouring and the time which elapses before the metal sets in the mold, which in the case of the low-silicon and low-carbon iron is at its minimum, control to a great extent the structure and physical properties of the metal. The effect of the nature of the mold also can be demon-

Table I

Mixtures Without Steel Scrap

Cupola Mixture No. 1

Pig iron	Silicon	Sulphur	Phosphorus	Manganese	Combined carbon	Graphite	Total carbon	Percent used
A	2.50	0.024	0.65	0.80	0.40	2.75	3.15	25
B	2.00	0.015	0.55	0.70	0.35	2.80	3.15	25
Return (cast scrap)...	1.95	0.080	0.55	0.60	0.40	2.60	3.00	50

The pig irons designated as *A* and *B* are referred to as strong northern iron. The average chemical analysis of the test bar, as given for return scrap.

Cupola Mixture No. 2

Pig iron	Silicon	Sulphur	Phosphorus	Manganese	Combined carbon	Graphite	Total carbon	Percent used
C	2.60	0.030	0.60	0.70	0.20	3.00	3.20	25
D	1.95	0.025	0.51	0.78	0.30	3.30	3.60	25
Return	1.96	0.081	0.50	0.58	0.41	2.70	3.11	50

The pig irons designated as *C* and *D* are referred to as weak southern iron. The average chemical analysis of the test bar, as given for return scrap.

Average physical properties obtained from 30 heats:

	No. 1	No. 2
Tensile strength, pounds per square inch (bar poured on end, 1½-inch round x 12 inches long)	32,000	25,000
Transverse strength (bar poured on end; 1 inch square x 13 inches long; knives 12 inches apart; dead load at center)	3,350	2,650
Deflection (on same bar as transverse strength)	0.15 inch	0.12 inch

The author is metallurgical engineer, Midwest Engine Co., Indianapolis, Ind.

strated by pouring any metal into molds of similar form, with dry-sand, green-sand and chill molds. For example, low-silicon and low-total-carbon can only be used for heavy castings when poured in green-sand molds, or for small castings in dry-sand. Otherwise, the cast iron is naturally susceptible to surface chills, which cause trouble in machining.

It is a known fact that in the best cupola practice, it is better to use certain brands of pig iron whose chemical composition is near that required for the casting, to give the required physical properties and to obtain a uniform product. Consequently in the case where high physical properties are required, it is better to use strong irons with a large percentage of return scrap to obtain these properties, than to resort to the use of steel, thus avoiding the use of extremes in the cupola, and more especially in the small cupola, or with short heats.

It may also be noted to advantage that those who desire to obtain castings of high physical properties should stipulate the minimum tensile and transverse strength required with the deflection, than to call for *semisteel* without the minimum limit on its physical properties, for the reason that by chemical analysis or physical test, a chemist cannot positively state whether or not steel has been used in any proportion. In addition, if steel had been used in such a casting, it need not necessarily comply with specifications given.

Table II

Mixtures With ahd Without Steel

Cupola Mixture No. 3 (Steel scrap used)

Pig iron	Silicon	Sulphur	Phosphorus	Manganese	Combined carbon	Graphite	Total carbon	Percent used
A	4.060	0.024	0.508	0.907	0.200	2.95	3.15	20
B	1.951	0.025	0.374	1.190	0.500	3.25	3.75	15
C	1.714	0.039	0.180	0.650	0.600	2.90	3.50	10
Return scrap	2.001	0.075	0.300	0.750	0.500	2.60	3.10	40
Steel scrap	0.100	0.045	0.020	0.450	0.200	....	0.20	15

Pig iron designated as *A*—Southern iron, *B*—Northern iron, *C*—Malleable bessemer iron. The average chemical analysis is approximately as given for return scrap.

Cupola Mixture No. 4 (No steel scrap used)

Pig iron	Silicon	Sulphur	Phosphorus	Manganese	Combined carbon	Graphite	Total carbon	Percent used
D	3.00	0.025	0.480	0.603	0.30	2.85	3.15	20
E	1.75	0.024	0.632	1.640	0.45	3.10	3.55	20
Return scrap	1.95	0.083	0.533	0.714	0.55	2.50	3.05	60

Pig iron *D* and *E* are strong northern iron. The average chemical analysis of the test bars is approximately as given for return scrap.

The average physical properties obtained from 30 heats, ran as follows—test bars taken as in previous description:

	No. 3	No. 4
Tensile strength, pounds per square inch (bar poured on end, 1⅛-inch round x 12 inches long)	29,650	31,800
Transverse strength (bar poured on end; 1 inch square x 13 inches long; knives 12 inches apart; dead load at center)	2,940	3,230
Deflection (on same bar as transverse strength)	0.12 inch	0.14 inch

Figure Costs on an Engineering Basis

BY W. L. CHURCHILL

FOUNDRIES are backward in their development of a proper basis for determining the three costs of their products and of properly pricing them. The majority of foundrymen are so thoroughly and completely engrossed in the technical processes and operating details that they are forced to neglect matters pertaining to the proper determination of costs and selling prices, and arrive at these by haphazard estimating. Also, many foundrymen recognizing their own inability to give time and thought to these problems, delegate them to their bookkeepers or accountants who compile costs and establish selling prices without the proper technical knowledge of foundry processes.

To determine costs of foundry products is far more an engineering problem than one of bookkeeping or accounting. To know their costs foundrymen must resort to engineering analyses of their cost factors and build up their costs by assembling such information. In many respects this is a fortunate circumstance as most foundries are obliged to quote prices before they produce castings for their customers. It means that they must predetermine the costs of their prodcuts or else make estimates that have sufficient margin of safety to insure against loss. Too few foundrymen realize that estimates can be made in such thorough and complete manner from cost standards and by formulae developed from engineering analyses of all cost factors pertaining to their operations that such estimates become the actual product costs. When foundrymen realize that one trained cost engineer, who can be quickly developed in their own plant, can establish costs in advance of production for as many as 150 employes the demand for such cost engineers will become insistent.

The cost engineer is an estimator who by knowing all of the operations that any given product requires for its production makes up once, and once only, a cost schedule for each and every article that is required to be produced. He does this advance costing by first preparing the cost standards for all equipment, for all operations and for all conditions of volume output, etc. Having established these standards his work is subject to audit and proof by the bookkeeping or accounting department which use his schedules of positive cost knowledge in place of the usual heterogeneous masses of time tickets and other voluminous records of workers' activities.

The typical collection methods of costing are not suited to foundry purposes regardless of their merit in other lines. Unless operated by exceptionally intelligent and resourceful people they are apt to be misleading in their cost conclusions. Fortunately, this principle of costing is applicable to the smallest as well as the largest foundry. In the small jobbing foundry employing but few men, the owner operator becomes his own cost engineer, while in the larger plants someone devotes part time to the cost engineer duties and if the shop is large enough there may be one or more cost engineers.

To most foundrymen who hear the assertion that estimates can be the true costs, the question arises as to whether assurance can be given of castings or any other goods, being produced at exactly the cost estimated for their production. The engineer contends that the cost of products are those factors of cost that must unavoidably be incurred to produce castings, or any other article. Certain costs should be charged to the customer in the selling price; other costs cannot specifically be

Abstracted from a paper presented at a recent meeting of the Metropolitan Brass Founders' association, New York City.

charged to the customer as he, or his products, are in no way responsible for them. To illustrate, when a molder spoils a set of molds and is obliged to make a duplicate set, a customer cannot be expected to pay for molding the castings twice. The foundry will have to bear this loss by charging it against profits.

Once this principle is accepted as a correct one, it then becomes merely a matter of insuring that every cost factor is included in all advance cost estimates with allowances for average slippage, spoilage, etc., so that all customers bear a pro rata share of such losses and inefficiencies.

Another advantage of this type of costing in foundries is that it enables the management to obtain records of departmental and plant efficiencies. In many instances the man-hour output has been increased more than 30 per cent in the course of a few months of measuring output against cost standards established by the cost engineer. Another advantage of using the principles of engineering standards is that many of the illusive cost factors in foundry practice becomes definitely fixed in regard to their effects upon costs and selling prices.

The next important factor for insuring foundry profits is to know how to apply profits to costs in establishing the proper selling prices with which to charge customers for castings or other goods. Profits should be based on what the foundrymen sells. Few of us realize that when we make castings, what we are really marketing is our ability to convert metal into the shapes that our customers desire. The great majority of foundries class this ability as a commodity on an equal basis with the metal. It is an almost universal practice of establishing some one rate per pound, or some one ratio to total cost, in arriving at the proper selling prices. This practice puts excessive profits on goods or castings whose proportion of metal values are high, and penalizes those goods where the effort of converting a small amount of metal into intricate and difficult shapes is greater in proportion to the value of the metal used.

When foundrymen cease to figure profits on a basis of metal value in their goods, but figure it on the value of the effort required to convert this metal into products, they will find it matters not whether they are handling heavy or light tonnage per employe, the ultimate returns to the business can always be kept at a satisfactory figure when the normal force is consistently employed.

Location of Gates Plays Important Part

By Thomas Nelson

While reading the interesting article in THE FOUNDRY of Dec. 1 describing the methods employed in molding and pouring bath tubs, I was reminded of a peculiar experience many years ago in the old country while engaged in making a water cistern for a blacksmith tuyere. It was a plain box 20 x 20 inches, 10 inches deep with a bottom, but no top and was molded bottom up so that the pattern left its own green sand core in the drag. The casting had a metal thickness of ¼-inch and was poured through two small pop gates spaced about 6 inches apart and fed from a basin built up on the center of the cope. Apparently the job was plain and simple and within the capacity of any ordinary molder and yet every casting made was covered with scabs on the inside near both ends. Eventually, the molders developed the habit of covering the surface with the heads of large nails and that stopped the scabbing, but the practice did not appeal to me and when I received an order to make 12 castings I decided to find an easier and more workmanlike method of producing clean castings.

I molded and vented the first one with unusual care, gated it in the regular manner but it scabbed just as badly as others I had seen in which the sand was rammed so hard that the vent wire had to be driven in with a hammer. On the second mold I employed a single flat stove plate gate on the center, but the face scabbed as usual. I tried another with the runner set at right angles to the first position but the result was the same and then I began to wonder if the slow dribbling stream over the ends was not the cause of the trouble. I tested the theory on the fourth casting and found I was right.

I placed a gate about 2 inches from each end and then built a large pouring basin on the cope. The ladle of iron was dumped in the basin which then fed the gates until the mold was filled. All subsequent castings were poured in the same manner and we had no further scabs.

Wet Chuck Holds Work in the Turning Lathe

By C. G. Spicer

Frequently the necessity arises, in turning wood patterns, of providing a special holding device. One of these constantly used by the writer is shown in the accompanying illustration. A block of wood is screwed to the face plate of the lathe and a cavity is turned in it corresponding to the outside diameter of the pattern to be finished. The cavity is wet with a rag or piece of waste at several points on the circumference and then the pattern is pressed into place. Wetting the block causes it to swell and grip the pattern tightly.

Steel Castings Exports

Export of steel castings for the year 1922 amounted to 2215 tons, and of iron castings to 10,190 tons, according to a report of Luther Becker, chief of the iron and steel division of the department of commerce.

Incorporates Foundry

The Meier-Mee Foundry Co., Detroit, with $15,000 capital stock, has been incorporated to do a general foundry business. The incorporators are Edward L. Meier, 11 Hartford street and Gilbert H. Mee.

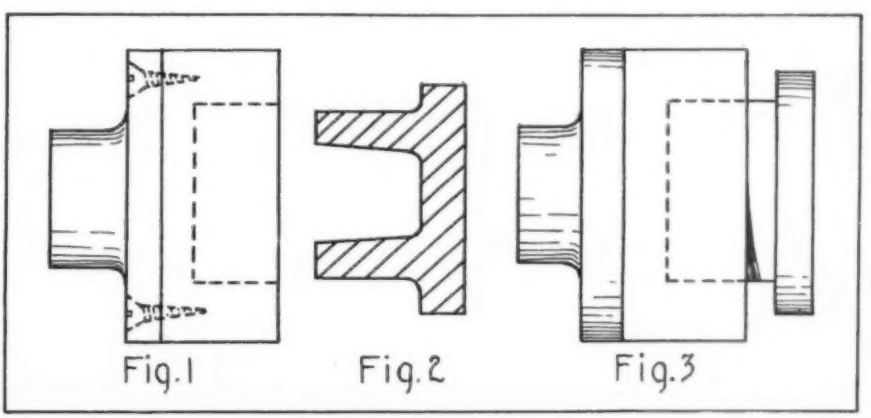


FIG. 1—BLOCK ATTACHED TO FACE PLATE FIG. 2—SECTION OF TYPICAL PATTERN TO BE FINISHED FIG. 3—PATTERN IN PLACE IN THE BLOCK

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Calculations Should Base Decisions

IN SOME cases it is evident that not enough forethought is given to designing a foundry or installing equipment. Undoubtedly it is well to have a modern up-to-date foundry, but this does not consist of the purchase and installation of all the available types of machinery on the market nor the adoption of devices for carrying the iron to the cupola and handling the molten metal in the foundry. Conditions differ so widely in various shops that what is economical in one foundry is wasteful in another. The continuous process of molding and melting has proved highly beneficial in certain shops where the output is large and the size of the work produced lends itself readily to this method of operation. However, it is self evident that this method does not offer advantages under all conditions.

In some cases the advantages of the continuous process are so plainly evident that not enough consideration is given to weighing them against the disadvantages which are not always so plainly evident. The allurement of being thought progressive is so tempting that caution which usually controls the executive sometimes is thrown to the winds. Too, in large corporations, it sometimes happens that one department builds the shop and another operates it. In such cases the operating division does not always have as much control over expenditures for equipment as it should and the foundryman must make cheap castings using a plant built for him by the engineer who may not be as familiar with foundry details as he should be. If the designer is a competent foundry engineer, his plant may be of such a nature that more technical knowledge is required to operate it than is possessed by the operating head. In either event a struggle ensues to meet the interest and depreciation charges. This is especially true when business is slack. Some equipment readily pays for itself when the shop is operating to capacity, but when on part time operation shows an excessive overhead expense.

Therefore, it is necessary to calculate conditions before deciding on equipment. Of course, the foundryman who does not make a study, but blindly decides without investigation that certain equipment is too expensive for him, is as much at fault in his extreme conservatism.

A concrete example which illustrates the necessity for calculating carefully the advantages and disadvantages of an installation is furnished by the electric furnace. In the steel foundry this melting medium has proved of unquestioned benefit to many foundries, and few, if any, have found the expense of electric melting to be excessive. But in the brass castings industry a number of shops have found that the cost of operation on less then continues operation is excessive, and when the demand for castings falls off these plants go back to crucible melting. This gives them a cheaper metal, but the overhead of interest, depreciation and rent for the electric furnace is accumulating and will be an added burden when the furnace again is started. Obviously, before installing an electric furnace in the brass foundry calculations should be made with due caution considering the time of low production when the furnace will be lying idle. In the gray-iron shops the electric furnace is being found of great value in producing better metal under certain conditions and for definite purposes and many shops no doubt are missing benefits by not installing the electric furnace, but the decision should be made after considering all factors in each individual case. If it makes better castings cheaper, then install it.

Trade Outlook in the Foundry Industry

CONTINUED high rate operations characterize foundry conditions throughout the country. The unparalled activity in the many contributing lines of manufacture are rolling up totals of castings orders which closely approximate those encountered during the period of greatest prosperity following the war. Delays in deliveries, orders set ahead and even instances of work refused through want of plant capacity are the clearest indication of the periods demands. Difficulties in securing needed raw materials and the growing labor shortage also are heralds of the peak in castings production which is at hand.

Competition Enters

The spectacle of foundries bidding against each other for labor is common in the larger centers. Similarly, scrambling for coke and iron has been noted in some sections, notably in New England. However, in general, buying has not reached the point of feverish activity which the fear of shortages and higher prices sometimes induces. Purchases for normal consumption predominate, although some effort is being made to cover into the third and even the fourth quarter on iron. Few doubt that the present period of prosperity will extend well into the final quarter of the year, and for this reason plans are laid to meet the need of manufacture at least that far in advance. One line of castings manufacture which is accepted by many as a gage of the future trend is the cast iron pipe industry. Practically all foundries engaged in this class of work are sold through August and September, and although municipal demand is well supplied, the ordinary run of incidental sales to private interests and to foreign purchasers serve to keep up a strong volume of inquiry. Few bids are received on new projects, and this is a marked indication of general conditions in this line.

Prices of Raw Material for Foundry Use

CORRECTED TO APRIL 25

Iron		Scrap	
No. 2 Foundry, Valley	$31.00 to 32.00	Heavy melting steel, Valley	$25.75 to 26.00
No. 2 Southern, Birmingham	27.00 to 28.00	Heavy melting steel, Pitts.	24.50 to 25.00
No. 2 Foundry, Chicago	32.00 to 33.00	Heavy melting steel, Chicago	22.00 to 22.50
No. 2 Foundry, Philadelphia	31.76 to 32.13	Stove plate, Chicago	23.25 to 23.75
No. 2 Foundry, Buffalo	29.50	No. 1 mchy. cast, Chicago	28.00 to 28.50
Basic, Valley	31.00	No. 1 cast, Philadelphia	25.00 to 27.00
Basic, Buffalo	30.50	No. 1 cast, Birmingham	24.00 to 25.00
Malleable, Chicago	32.00 to 33.00	No. 1 cast, Buffalo	25.50 to 26.00
Malleable, Buffalo	30.00	Car wheels, iron, Pitts.	27.00 to 27.50
Coke		Car wheels, iron, Chicago	26.50 to 27.00
Connellsville foundry, coke	$7.50 to 8.00	Railroad malleable, Chicago	28.00 to 28.50
Wise county foundry, coke	8.25 to 8.75	Agricultural mal., Chicago	26.50 to 27.00
		Malleable, Buffalo	27.00 to 28.00

Auto Sales Phenomenal

Precedent has been overthrown so frequently in automobile manufacture, that the latest developments in this giant industry occasion interest but not surprise. More cars were made during March than during any month in the history of the industry. The total 353,017 passenger cars and trucks built by automobile manufacturers during the past month excelled by 20 per cent the previous record of 289,000 cars made in June, 1922. For the first quarter, the aggregate output was 768,000 cars which is 133 per cent more than the total made in the corresponding period last year. March surpassed by 25 per cent the mark set by February. Sales are more than keeping pace up to the present, with the output of the factories, and from present indications no slackening is likely to abate the demand which has supported a manufacturing rate of over 4,000,000 cars per year. Prices have been advanced by many of the makers of popular type automobiles, induced, as is explained by the manufacturers, by higher wages and stronger material prices. Cylinder and other auto parts foundries are actively engaged supplying the automotive de-

Rail Shops Saturated

Deliveries of railway equipment have been surpassed by orders. The railroads, faced by tremendous increases in traffic are making every effort to add to their facilities. The expenditure of over a billion dollars in new equipment and improvements in 1923 is well under way. During the first three months of the year, the railroads have purchased 65,000 cars. This compared with the total of 37,500 cars ordered during the corresponding period of 1922 gives indication of the increased rate of buying now prevailing. The railroads during the first quarter of this year have ordered 4219 new locomotives, of which more than half already have been placed in operation. The shipments of locomotives during the present year are the largest since December 1920, according to the department of commerce. Car orders are somewhat lighter during the past two weeks, but shops are filled and foundries handling railway castings are working to capacity. Steel and malleable foundries in particular have profited by this class of castings demand. Bookings of steel castings during March totaled 143,564 tons or 148.2 per cent of capacity, while railway specialty steel casting orders placed reached 199.5 per cent of capacity. Malleable foundries too are active and inquiries are widespread. A case in point is the inquiry of Shelby Metal Products Co., Shelby, O. which is seeking to place small malleable castings.

Nonferrous Operations

With the tremendous strides made in constructional lines and the increased demand from automobile and miscellaneous sources, nonferrous foundries are working at top speed. Authorities prophecy a severe shortage in plumbing and heating material before the end of the season unless the present building situation is relieved. Prices for nonferrous metals, according to New York reports in the Daily Metal Trade of April 25, follow: Casting copper, 16.50c to 16.62½c; electrolytic copper, 17.00c; Straits tin 44.37½c to 44.50c; lead, 7.90c to 8.00c; antimony, 8.00c; aluminum, No. 12 alloy, open market, 24.50 to 25.00. Zinc is 7.05c, E. St. Louis, Ill.

Comings and Goings of Foundrymen

DR. GEORGE KIMBALL BURGESS, since 1913 chief physicist and head of the division of metallurgy of the United States bureau of standards at Washington, has been made chief of the bureau by Secretary of Commerce Hoover. Dr. Burgess succeeds Dr. S. W. Stratton, who resigned on Jan. 1 to become president of the Massachusetts Institute of Technology, at Boston. Dr. Burgess, who was born at Newton, Mass., on Jan. 4, 1874, received the degree of B. S. from the Massachusetts Institute of Technology in 1896. In 1901 he was made a doctor of science by the University of Paris. After teaching physics at his alma mater and at the University of Michigan and the University of California, Dr. Burgess became associate physicist of the U. S. bureau of standards in 1903. Ten years later he was made chief physicist and head of the division of metallurgy. He is a member of the National Academy of Sciences, the institute of metals, division of the American Institute of Mining and metallurgical Engineers, the Iron and Steel Institute of Great Britain, the Washington Academy of Sciences, the National Research council, the French Physical society, and the Philosophical Society of Washington, also of the American Society for Testing Materials, of which society he was made president at the last election.

Harry W. Farris is now connected with the McMyler-Interstate Co., Bedford, Ohio.

James H. Wilkins has been appointed general manager of the Reliance Foundry Co., Slinger, Wis.

Mark Kuehn, National Malleable Castings Co., Cleveland has been elected director of the Cleveland Purchasing Agents' association.

Fred Schopp, formerly with the Kedzie Foundry Co., Chicago, has been promoted to the foremanship of the Swartz Mfg. Co., Freeport, Ill.

Thomas L. Neston, Fitchburgh, Mass., has been appointed employment manager of the Crompton & Knowles Loom Works, Worcester, Mass.

John Haag, core room foreman, Aultman & Taylor Machinery Co., Mansfield, O., has been appointed foundry superintendent.

Thomas Vickery has accepted a position with the Union Tool Co., Torrance, Cal. Mr. Vickery was formerly foreman of the P. David Co., San Francisco.

Richard H. Mehrman, formerly with the Portage Lake Foundry & Machine Co., Hancock, Mich., is now general foreman of the Detroit Gray Iron Foundry Co., Detroit.

Ben Lafever, formerly of Hammond, Ind., assumed the duties of foundry superintendent of the Calumet Castings Corp., Griffith, Ind.

C. A. Moore has been appointed district sales manager at Chicago for the U. S. Reduction Co., with offices at 110 South Dearborn street. He formerly was with the Aluminum Castings Co., Cleveland.

Ralph W. Clark, manager, pig iron department, Pilling & Co., New York, has arrived in London. Mr. Clark expects to spend some time in England and on the continent studying international pig iron and fuel trading conditions.

George A. Hofmeister, who resigned his position as night superintendent of the Detroit Steel Casting Co., Detroit, at the end of February on account of ill health, is now convalescing from a operation at the Buffalo Homeopathic hospital, Buffalo.

J. B. Craig has resigned his position as foundry superintendent of the Canadian General Electric, Ltd., Toronto, Ont., Canada, with which company he has been employed since 1920, to accept the position of foundry manager with Charles Walmsby & Co., (Canada) Ltd., Longueuil, Que.

J. B. Warren has been re-elected president of the Penn Seaboard Steel Corp., Philadelphia. C. F. Jemison was elected vice president and treasurer and M. S. Hager secretary and assistant treasurer, W. P. Barba has become chairman of directors. Mr. Jemison, who remains as treasurer, succeeds George Satterthwait, who recently resigned as vice president of the company.

John Hunter, a foundryman from Armedale, Scotland, who has had experience in teaching foundry work in that countrw, spent a few days in the early part of April visiting Professor J. D. Hoffman and Instructor R. E. Wendt at Purdue university, Lafayette, Ind. He was interested greatly in the foundry course being taught under the direction of Mr. Wendt.

A. G. Hopcraft, purchasing agent for the Ferro Machine & Foundry Co., Cleveland has been re-elected president of the Cleveland Purchasing Agent's association, this being the first time in eight years a re-election has been made to this office. Mr. Hopcraft also was chosen a national director for two years, and was presented a gold watch by the members in appreciation of his aid in bringing the national convention to Cleveland for May 15 to 18.

M. M. Marcus has resigned as vice president and general superintendent of the Rhode Island Malleable Iron Works, Hill's Grove, R. I., to become associated

FAKED FOUNDRY FACTS

THE CLEANING ROOM

with the Gulick-Henderson Co., New York, engineer, metallurgist and chemist. He will be connected with the company in the capacity of consulting engineer in charge of the foundry department. His entire time will be devoted to consulting foundry engineering. He will continue to serve on the committee of molding sand research and the subcommittee on conservation and reclamation of molding and core sand of the National Research council.

Louis C. Pawelk has been appointed assistant superintendent of the Burnside Steel Co., Chicago.

Leon E. Thomas, president of the Reading Iron Co. and the Thomas Iron Co., has been elected president of the Ironton railroad with headquarters at Reading, Pa. He succeeds W. A. Barrows Jr.

Frank E. McKanna, formerly foundry superintendent of the Pangborn Corp., Hagerstown, Md., has been appointed general foundry foreman at the River Rouge plant of the Ford Motor Co., Detroit.

W. M. Meyers has been appointed works manager of the Bucyrus Co., South Milwaukee, Wis. He formerly was assistant to the president, who is W. W. Coleman, president of the National Metal Trades association.

Norman H. B. Keysor, managing director, K. F. B. Foundry, Ltd., Sidney, Australia, is visiting this country to secure information in regard to molding machines, sand blast and other equipment for a new sanitary ware foundry his company is planning to build. Mr. Keyser will leave for Europe May 4 and will visit England, France and Germany before returning to this country in August on his way back to Australia.

H. J. Young, chief chemist and foundry manager, North Eastern Marine Engineering Co., Wallsend-on-Tyne, England, has been awarded the medal given every year by the British Institute of Marine Engineers for the best paper read before the institute during the preceeding year by a nonmember. Mr. Young's paper was published in THE FOUNDRY on April 15, 1922 under the title of "Engine Castings Requirements are Rigid."

Emile Ramas, president of the Association Technique de Fonderie de France, arrived in New York April 21 to attend the annual meeting of the American Foundrymen's association at Cleveland. The purpose of Mr. Ramas' trip is to invite American foundrymen to the international foundrymen's congress in Paris in September. Mr. Ramas is director of the Societe Francaise Metallurgique (Procedes Griffin), 2 Rue de Constantinople, Place de l'Europe, Paris.

International Foundry Exhibit Planned

Detailed arrangements are being made for the International foundry exhibition which will be held in Paris in September, at which a large number of American and English visitors are expected. The dates of the exhibition have been changed. Under the new plan it will open Sept. 2 and continue until Sept. 16. The dates of the convention are unchanged and the tentative program which is subject to future modifications is as follows:

Wednesday, Sept. 12

9:00 a. m.—Registration; reception of foreign delegates.
10:00 a. m.—Opening session under the chairmanship of the under-secretary of technical instruction. Reading and discussion of papers on general topics.
3:00 p. m.—Reception of American and English delegations.
4:00 to 6:00 p. m.—Inspection of the Ecole des Artes et Matiers; ladies included.

Thursday, Sept. 13

9:00a. m.—Session in French for reading and discussion of papers. Visit by the ladies to the Louvre and motor trip through Paris.
9:00 a. m.—Session in the English language for reading and discussion of papers by A. F. A. and I. B. F.
2:30 p. m.—Visits to foundries in Paris and vicinity. For the ladies a visit to the museum of the Luxembourg.

Friday, Sept. 14

9:00 a. m.—Session in the French language for the reading of papers on malleable and steel castings.
10:00 a. m.—For the ladies, visit to the Eiffel tower.
1:00 p. m.—Professional sessions adjourn to Eiffel tower for lunch joining ladies.
3:00 p. m.—Visit to foundries in Paris and vicinity. For the ladies a visit to the Invalides.

Saturday, Sept. 15

9:00 a. m.—Professional session in French for the reading of papers on nonferrous metals.
1:00 p. m.—Trip by excursion steamer on the Seine to St. Germain. Lunch on steamer. Return to Paris at 5:30 p. m.
7:30 p. m.—Annual banquet.

Discuss Problems of the Pattern Shop

Pattern shop problems were discussed at the regular monthly meeting of the Quad City Foundrymen's association, held at the chamber of commerce, Moline, Ill., Monday evening April 16. Herman Heidbreder, president, Central Pattern Works, Quincy, Ill., spoke on the relations between the user of castings, the pattern shop, and the foundry, and George Pearce, foundry engineer, Union Malleable Iron Works, East Moline, Ill., presented a paper on "High Production Patterns." Both speakers brought out the point that in production work it is not always the best to put a job on a match plate. In the discussion which followed, the consensus of opinion seemed to be that in many cases patterns are being put on plates that should be gated. In some cases, it was decided, the better way is to place the gated pattern in a frame and thereby secure the accuracy of a gated pattern and the advantage of a plate, inasmuch as it is possible to attach a vibrator to the plate and eliminate hand rapping. The discussion also brought out the fact that the pattern shop could assist the foundry by marking loose pieces so that the foundryman can assemble a difficult pattern more readily. It was suggested that on jobbing work, and especially on large wooden patterns, all machined surfaces should be painted a distinctive color to indicate to the foundryman the portions of the casting surface which must be kept clean.

Report on Molding Sand

A preliminary report to the Joint Molding Sand Research committee on the conservation and reclamation of sands in aluminum-alloy foundry practice has been submitted by R. J. Anderson, metallurgist of the United States bureau of mines. It has been found that no attempts are made to reclaim used sands in practice. A report on data submitted by aluminum foundries in reply to a questionnaire is in process of preparation.

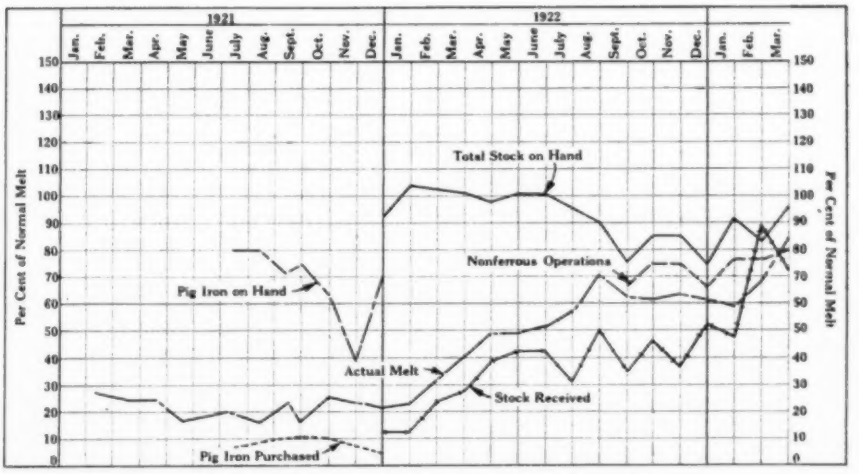
Ohio Foundry Operations Show Improvement

Report of operating conditions in Ohio foundries for the month of March as supplied by Arthur J. Tuscany, secretary-manager of the Ohio State Foundrymen's association, show a satisfactory increase over conditions obtaining in February and in fact over any preceding month since September, 1922. By referring to the accompanying chart it will be noted that the industry operated at 83.2 per cent of normal in March. This compares with 67.8 per cent of normal during February and 39 per cent during March, 1922.

The normal melt figure constitutes the total capacity of all foundries reporting. If all the foundries had sufficient business to operate at capacity there could have been produced during March 25,844 tons of castings. Since all the foundries did not operate to capacity the total amount produced only equaled 22,602 tons, an actual melt of 83.2 per cent. The total stocks on hand also show an increase to 25,617 tons. This compared with the normal melt figure of 25,844 tons equals 95.2 per cent, the highest point this figure has reached for almost a year. In March, 1922, the figure stood at approxi-

mately 100 per cent. At that time operators were obliged to take deliveries on many contracts and in addition business had tapered off to some extent. Stocks received amount to 19,406.05 tons which is 73 per cent of normal. In February this figure stood at 99 per cent and compares with 28 per cent for March, 1922. On the accompanying chart it will be noted that the various lines have been working to a point where during March they all stand close to the same general position on the graph.

Expectation of an upward trend of business on the part of nonferrous operators have been realized to the extent that the figure was raised from 76 per cent to normal in February to 80.2 per cent in March. A continuance of the factors in force last month would seem to indicate further activity for nonferrous operators. The percentage of increase in the nonferrous field did not equal that in the ferrous field, nevertheless the increase is regarded as fairly satisfactory.


1921
1922
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
Jan. Feb. Mar.
Per Cent of Normal Melt
Per Cent of Normal Melt
Total Stock on Hand
Nonferrous Operations
Pig Iron on Hand
Actual Melt
Stock Received
Pig Iron Purchased

OHIO INDUSTRIES SHOW GAINS IN MARCH

Addresses Philadelphia Foundrymen

A planked shad dinner attracted a large number of foundrymen to the regular monthly meeting of the Philadelphia Foundrymen's association, Wednesday evening, April 11. Charles F. Hopkins, shop manager of the Ajax Metal Co., and practical metallurgist gave an interesting talk on brass foundry practice.

New England Meeting

Frank W. Brooks, chief engineer, William Swindell & Brothers, Pittsburgh, addressed the regular monthly meeting of the New England Foundrymen's association, held at the Exchange club, Boston, Wednesday evening, April 11. He dealt with the application of electricity in connection with mold drying, core baking, heat treating and melting. A discussion followed the address, and many questions were answered by the speaker.

Well Known Foundryman Dies in Chicago

P. C. Peterson, prominent foundryman, particularly in the Chicago district where he has been employed continuously by the W. A. Jones Foundry & Machine since the inception of the business in 1890 and as general foundry superintendent for over 20 years, died in that city on April 14 at the age of 63 years and 11 months. The late Mr. Peterson was born at Friehen, Sweden, on May 14, 1859. He was a practical molder of the old school and a constant student in the foundry field through the course of his long and active career. He was a member of the Chicago Foundrymen's club and also of the American Foundrymen's association and was a regular attendant at the monthly meetings of the one and the annual conventions of the other. He is survived by a widow, one son and two daughters.

Obituary

William Addison Burnham, president of the Lord & Burnham Co. and the Burnham Boiler Corp., both of Irvington, N. Y., died suddenly of heart disease on April 19 at his home in that city. Mr. Burnham was 76 years of age and had lived in Irvington for 50 years. He was a director of several banks and interested in other lines of industry. Mr. Burnham also was president and director of the Lord & Burnham Co., Ltd., of Ontario.

Frank R. Beal, 78 years old, founder of the American Bell & Foundry Co., is dead in Detroit.

George W. Woodbury, president of the Wollaston Foundry Co., Wollaston, Mass., died at his home here last week.

John P. Eustis, founder and treasurer of the J. P. Eustis Mfg. Co., Cambridge, Mass., brass founder, died unexpectedly in New York, while returning from a theater, April 6, aged 65 years. His home was in Newton, Mass. His two sons, Warner Eustis and Grant B. Eustis, Watertown, Mass., are associated with the company.

William J. Bohn, employment manager Chas. B. Bohn Foundry Co., Detroit, was shot and killed by payroll bandits Saturday, April 14, while conveying money to meet the payroll, from the bank to the plant. Experience gained in 14 years of western plains life enabled Mr. Bohn to save the lives of his three companions, protect the payroll, kill one of the robbers and rout the others, but in the exchange of shots he was fatally wounded and died shortly afterward in Receiving hospital. The late Mr. Bohn was a veteran of the Spanish-American war. He was an expert horseman and during his 14 years in the West had been a cowboy, rancher, farmer and teacher of pistol and rifle shooting in Nebraska, Texas, Wyoming and Idaho. He is survived by a widow.

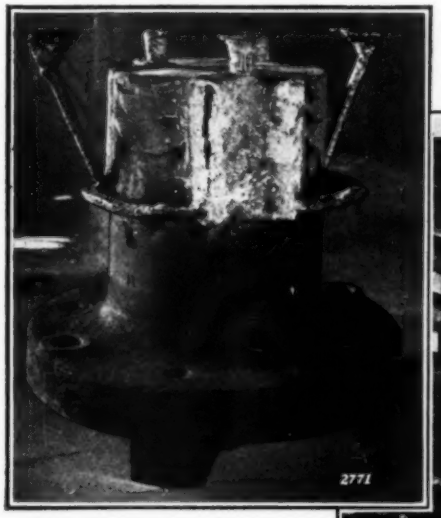
Two Unusual Welds Made Successfully

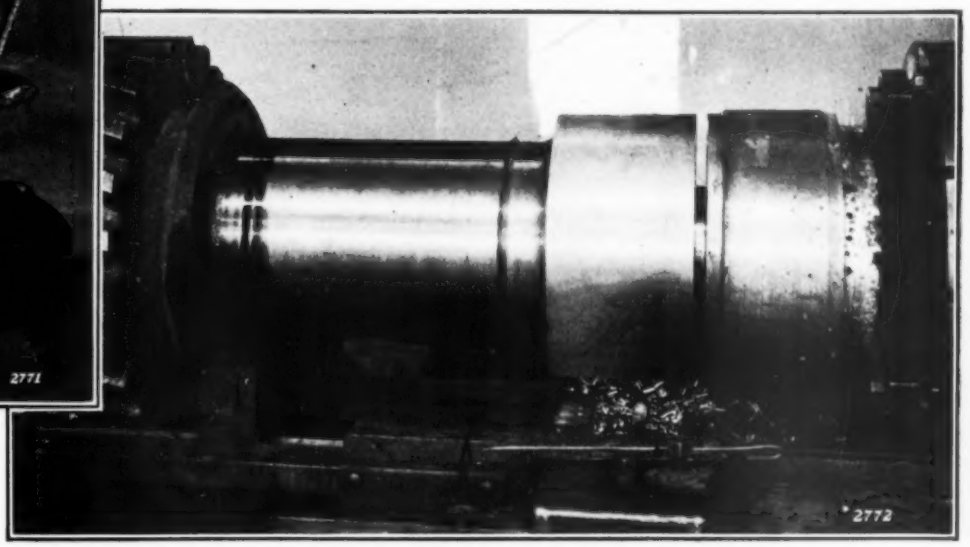
Repairing of a broken pinion neck and a blooming mill crab in a large steel plant near Pittsburgh recently was accomplished successfully by using the thermit weld method. The accompanying illustrations show the satisfactory results accomplished in these two repairs. In the case of the pinion neck, the new metal starts at the shoulder over the wood steady rest, as shown in the illustration, and continues the length of the neck. The metal, upon being machined, was found to be free of blow holes on the bearing, and only a few defects were encountered at the point of cutoff at the end of the neck.

In preparation for the weld, the pinion was placed on end with the end requiring the new neck uppermost. A mold was so constructed around the section as to permit the casting of a new neck. The original section was then preheated to red heat, after which liquid steel produced in a crucible by the thermit reaction at a temperature of 5000 degrees Fahr. was allowed to flow over the fractured surface. This completed the heating operation and brought the surface to be welded at the end of the neck to the melting point. The supply of liquid steel from a ladle was then tapped into the mold and allowed to wash

through an overflow into an ingot mold, preventing waste of excess metal. The overflow gate was then closed and the mold filled to the top.

The analysis of steel used to cast the neck was as follows: Carbon, 0.44; manganese, 0.51; phosphorus, 0.007; sulphur, 0.037; silicon 0.17 per cent. A high percentage of silicon will be noted, which is unusual in basic open-hearth steel. This addition was made in the ladle.





(LEFT) WELD ON BLOOMING MILL CRAB. (RIGHT) PINION NECK WELD REQUIRING 500 POUNDS OF METAL

The new metal on the blooming mill crab, which is also shown in the accompanying illustration, starts at the riser. Practically the same method was used in the welding of this casting as was used in repairing the pinion neck. The work was done under the supervision of the Metal & Thermit Corp., 120 Broadway, New York.

Withstands Short Excess Currents

Recently, the Federal Electric Co., Chicago, has designed a new, renewable, powder-packed fuse plug, which it is stated will prevent the destruction of small motors and apparatus. The advantage claimed for this plug is its ability to withstand the short excess currents caused by high starting torque, and the accuracy with which it blows within the required time to protect the apparatus.

Its construction is simple. The three parts are, Fig. 1, the powder packed renewable cartridge, Fig. 2, the cartridge holder, and Fig. 3 the outer case. Only the cartridges furnished by the manufacturer may be used.

United States Uses Much Plumbago

The United States has been by far the largest purchaser of Ceylon plumbago during the past ten years, and took 134,893 hundredweight, or 64 per cent of the total exports of 1922. This is an increase of 213 per cent over the imports of America in 1921, when only 43,062 hundredweight was imported. Compared with 1916, the peak year, when 503,741 hundredweight was shipped into this country, the amount still is short of 368,848 hundredweight or 73 per cent of the total imports of that year. If 1913 is taken as a basis for calculations, and this being usually considered a normal year, plumbago imports still are on the up-grade. In 1913 the imports were 289,218 hundredweight, or 52 per cent more than the past year, in other words only half as much as normally need to supply the foundry trade is being imported.

Importations of the other countries, all show a healthy and flourishing condition. The United Kingdom and Japan each taking approximately 20,000 hundred weight. European conditions do not affect this commodity to any appreciable effect, Germany being the only other large importer. There has been a gradual decrease in the price since the war but thre was a tendency toward hardening during the final quarter of 1922. This has continued on into 1923 and is reflected in the fact that additional mines are being opened in Ceylon.

The chamber of commerce, Dunkirk, N. Y., Wallace A. Brennan executive manager, is seeking to interest some jobbing foundry in locating in that city.

FIG. 1—POWDER PACKED RENEWABLE CARTRIDGE FIG. 2—CARTRIDGE HOLDER FIG. 3—OUTER CASE

Equipment Sales Are Steady

Indications Point to Continued Sales of Foundry Machinery Which Will Be Characterized by Absence of Feverish Buying to Supply Immediate Needs

WHILE no sensational developments are noted over the past two weeks, a steady volume of orders continues to pile up on the books of foundry equipment manufacturers. A healthy condition is reported in all sections and inquiry is active. The Liberty Foundry Co., Inc., Wauwatosa, Wis., recently incorporated with William J. Grede as president, is erecting a plant which will require about $35,000 worth of foundry machinery. The W. W. Sly Mfg. Co. recently shipped a cinder mill to Metters, Ltd., Sydney, Australia. Other sales by the same company include dust arrester equipment to the Victor Stove Co., Salem, O.; Pierce, Butler & Pierce Co., Zanesville, O., and the Klein Mfg. Co., Cleveland. F. J. Ryan & Co,, Philadelphia. received a contract recently for a casting annealing furnace, one for rust proofing, one for carbonizing, three electric core ovens, 10 oil-fired brass furnaces and an automatic dipping and japanning furnace from the Reading Hardware Co., Reading, Pa.

Equipment Needs Decrease in Pittsburgh

FOUNDRIES in this vicinity maintain high rates of operation, but for the time being apparently have satisfied most of their equipment needs, except possibly molding machines. Occasionally, a purchase is noted of other forms of equipment and several inquiries now are out for core ovens, cupolas, sand mixers, etc. The Locomotive Stoker Co., Pittsburgh, closed on two tumbling barrels with an Erie, Pa., seller and the Pittsburgh Crushed Steel Co., Pittsburgh, is understood to be in the market for various forms of equipment. The E. T. Frain Lock Co.. Lancaster, Pa., is reported to have purchased all the equipment necessary for its new foundry except several squeezers, and the Pocomo Iron Foundry, Allentown, Pa., also has purchased a small amount of equipment. The Vanadium Alloys Steel Co., Latrobe, Pa., and the Wheeling Steel Castings Co., Wheeling, W. Va., each closed on a straightening machine. The major buying of equipment continues to be confined to the molding machine industry, manufacturers reporting the movement of mostly large units costing from $6000 to $14,000 each. The Herman Pneumatic Machine Co., Zelienople, Pa., for instance, sold the National Foundry Co., Erie, Pa., the largest jarring and rollover machine it has built. The plate will be 7 x 12 feet; it will jar 25 tons, and rollover 10 tons, and is to be used for pit plates for the Ball Engine Works, Erie, Pa. Other recent buyers of molding machines include the American Brake Shoe & Foundry Co., Chicago, one rollover machine; American Radiator Co., Buffalo, two large rollover machines; Ohio Steel Foundry Co., Springfield, O., one large rollover; the Machined Steel Casting Co., Alliance. O., one jarring machine; National Supply Co., Toledo, O., one rollover machine; National Boiler Companies, Garwood, N. J., two machines; American Locomotive Co., steel foundry, Chester, Pa., two large rollover machines, and the Isbell-Porter Co., Newark, N. J., one large jarring machine. The Reading Hardware Co., Reading, Pa., recently contracted with F. J. Ryan & Co., for an annealing furnace for cast iron, a furnace for rust-proofing, a carbonizing furnace, three electric core ovens, an oil-fived brass furnace, and an automatic dipping and japanning furnace, while the Keystone Foundry Co., Lebanon, Pa., bought a 7-ton cupola from the J. W. Paxson Co., Philadelphia, a battery of American Foundry & Equipment Co. molding machines, a Wilbraham-Green blower, and a core oven from the Swartwout Co., Cleveland. The United Steel & Car Co., Martinsburg, W. Va., is a possible purchaser of foundry and other equipment at an early date, having taken an option on a plant site in that locality. Various foundries continue to manifest interest in the crane market from time to time. The Reading Iron Co., Reading, Pa., asked for prices on a used 10-ton, 60 to 80-foot span electric traveling crane with a 150-foot runway. The Pittsburgh Plate Glass Co. is about to close on a 10-ton 2-cage crane for its Zanesville, O. plant. The Urick Foundry Co., Erie, Pa., recently asked for prices on two 3-motor electric traveling cranes with 27-foot span. The Philadelphia, Hardware & Malleable Iron Works, Philadelphia, recently has purchased a sand-blast mill from the W. W. Sly Mfg. Co., Cleveland, while the American Engineering Co., also of Philadelphia, has secured a complete sand-blast room and dust arrester equipment from the same maker. The Richmond Radiator Co., Uniontown, Pa., and the Standard Sanitary Co., Pittsburgh, have purchased grinding machinery for their enameling departments from the Hardinge Co., New York. Recent purchasers of sand blast equipment from the Pangborn Corp., Hagerstown, Md., include the Damascus Bronze Co., Pittsburgh, and the Wheeling Steel & Iron Co., Wheeling, W. Va.

New England Strong Customer

THE New England branch of the American Foundry & Equipment Co., New York, has made heavy sales of foundry equipment, especially sand cutters, during the past ten days. The following foundries recently have placed orders for one or more sand cutters: The United Shoe Machinery Co., Beverly, Mass.; Draper Corp., Hopedale, Mass.; Vulcan Iron Works, New Britain, Conn.; Hart & Crouse, Utica, N. Y.; Barstow Stove Co., Providence, R. I.; Arcade Malleable Iron Co., Worcester, Mass.; Hunt-Spiller Mfg. Corp., Boston; Guerney Heater Mfg. Co., Framingham, Mass.; Bilton Tool & Machine Co., Bridgeport, Conn.; Walker & Pratt Mfg. Co., Watertown, Mass.; Acme Shear Co., Bridgeport, Conn., and E. & T. Fairbanks & Co., St. Johnsbury, Vt. The Leonard & Baker Stove Co., Taunton, Mass., and the Old Colony Foundry Co., Bridgewater, Mass., recently have purchased tumbling mills from the W. W. Sly Mfg. Co., Cleveland.

Outlook Fair in Chicago District

ACTIVITY of demand for foundry equipment continues at Chicago, indicating that melters are keeping up their rate of operation and need additional equipment to handle the tonnage. Ladles and other small equipment are especially in demand and shops producing these are kept busy meeting demand for large and small sizes. Cupolas, tumbling barrels, cranes and larger pieces of machinery also are being sold readily. The Whiting Corp., Harvey, Ill., has sold a 72-inch cupola to Pierce, Butler & Pierce, Zanesville, O.; a 54-inch cupola to the Reading Hardware Co., Reading, Pa., and a 50-inch cupola to the Northwestern Foundry Co., Chicago. The same maker has sold a 25-ton handpower crane to the General Electric Co., Buffalo, N. Y.; a 15-ton electric crane to the Union Pacific railroad, for its Omaha shops, a 60-ton electric crane to Witherbee, Sherman & Co., Port Henry, N. Y.,

and a 5-ton electric crane to L. C. Moore, Pittsburgh. Machinery for the preparation and handling of sand, and molding machines of various types are also being sold readily for shipment from Chicago manufacturers to foundries in various parts of the country. The Pangborn Corp., Hagerstown, Md., recently has sold sand-blast equipment to the Hubbard Steel Co., East Chicago, Ind.; the Buick Motor Co., Flint, Mich., and the Chicago Great Western Railroad Co., Chicago. Among the recent purchasers of dust arrester equipment in this district are the American Malleables Co., Owosso, Mich.; the General Electric Co., for its Decatur, Ill., plant, and the J. I. Case Threshing Machine Co., Philadelphia, Pa.; both of these orders went to the W. W. Sly Mfg. Co., Cleveland. The latter interest also has sold sand-blast equipment to the Electric Steel Co., Chicago.

Few New Orders in the East

TRADING in foundry equipment is active despite a slight slowing up, due to the annual meeting and exhibit of the American Foundrymen's association, now held in Cleveland. Several sizable orders have been placed with others on the point of being awarded. The H. B. Smith Co., Westfield, Mass., is understood to be closing on a considerable list of miscellaneous equipment and another Massachusetts foundry is on the point of doing so. Other buyers include the Utica Heater Co., Utica, N. Y.. and Pierce, Butler & Pierce, New York, both buying large cupolas from the Whiting Corp. The cupola for the latter company is for installation at its plant in Zanesville, O. The Westinghouse Electric & Mfg. Co., recently brought out a list of eight cranes, of which possibly two were alternates, for a contemplated foundry addition at its South Philadelphia works. Later, however, this inquiry was at least temporarily withdrawn. The list included one 60-ton, 6-motor double trolley crane, 100-foot span with auxiliaries; two 60-ton, 7-motor cranes, with two 30-ton trolleys and two 10-ton auxiliaries; one 20-ton, 4-motor crane, 5-ton auxiliary, and 47-foot span; and three 10-ton, 4-motor cranes. 70-foot span and 5-ton auxiliary. The American Car & Foundry Co. has recently closed on two 5-ton electric overhead cranes to the Pawling & Harnischfeger Co. Included in projects contemplated is a foundry extension for the Colonial Brass Works. New Britain, Conn.; a 1-story foundry addition for the Rockwood Stove Works, Rockwood, Tenn., and a foundry for the Connecticut Brass Foundry, Waterbury, Conn. An unusual demand prevails for sand cutters, one leading seller asserting that business in this line has been as active as at any time in his recollection.

Activity is pronounced in light equipment and supplies in the eastern district. The American Brake Shoe & Foundry Co., Portsmouth, Va., recently has purchased tumbling mills from the W. W. Sly Mfg. Co., Cleveland, as has also Frazer & Jones Co., Syracuse, N. Y. The Pratt institute, the American Brake Shoe & Foundry Co. and the Erie Railroad Co. all of New York City, have purchased sand-blast equipment from the Pangborn Corp., Hagerstown, Md. The latter is a repeat order.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The plant of the Hill-Griffith Foundry Co., Cincinnati, recently was damaged by fire.

The Weichman Pattern Co., Cincinnati, recently increased its capital stock from $25,000 to $75,000.

The Bucyrus Co., Milwaukee, is taking bids for the erection of a 1-story addition to its plant.

The Standard Semi-Steel Foundry Co., Clinton, Mo., is reported planning the erection of a plant at Keokuk, Mo.

Willamette Iron & Steel Co., Portland, Oreg., is building an addition to its main office building, 80 x 100 feet.

The Taplin-Rice-Clerkin Co., Akron, O., plans to rebuild its foundry which was badly damaged by fire recently.

The Rome Stove & Range Co., Rome, Ga., has let the contract for the erection of a plant addition to cost about $20,000.

The Indiana Foundry Corp., Muncie, Ind., recently increased its capital stock from $50,000 to $175,000.

The U. T. Hungerford Brass & Copper Co., New York, plans the erection of a building at Boston, 2-stories, 80 x 240 feet.

The South Texas Implement & Machinery Co., Houston, Tex., has increased its capital stock to $185,000 and has changed its name to the South Texas Implement & Vehicle Co.

The F. S. Lang Mfg. Co., Seattle, manufacturer of stoves, has purchased additional land as a site on which it plans the erection of a plant addition.

Capitalized at $10,000 the Superior Brass & Mfg. Co., Kansas City, Mo., recently was incorporated by I. W. King, B. A. Butler and F. D. Miller.

With a capital stock of $25,000 the National Pump & Mfg. Co., Dallas, Tex., recently was incorporated by O. T. Liles, J. C. Munsie and J. C. McNeil.

The Crane Enamelware Co., Chattanooga, Tenn., has let the contract to the Austin Co., Cleveland, for the erection of a new plant unit.

The Reeves Foundry Co., North Logan avenue, Trenton, N. J., plans the erection of a 1-story addition to its plant to cost about $10,000.

J. H. Havin and Tumis Johnson have purchased the foundry of Connor & Richmond, Grand Rapids, Mich., and will take immediate possession.

The North Chicago Pattern & Machine Co., North Chicago, Ill., has been formed by Arthur Nelson, Louis Guenette and Ben Bowater.

The Union Hardware Co., Torrington, Conn., has let the contract for the erection of a 2-story addition to be 102 x 193 feet, to cost about $100,000.

The Arcade Mfg. Co., Freeport, Ill., has had plans drawn for the erection of a 1-story plant building to be built at an estimated cost of $60,000.

The Anderson Foundry & Machine Works, Anderson, Ind., has awarded a contract for the erection of an addition to its plant, 80 x 100 feet.

Capitalized at $500 the Selker Brass Mfg. Co., Cleveland, recently was incorporated by William A. McAfee, A. B. Oakes, Thomas F. Veach Leonard Smith and A. A. Stambaugh.

The Whitman & Barnes Co., Akron, O., has purchased a 15-acre site near Kenmore, O., and it is understood plans to utilize it as a site for a new plant. The company manufactures tools.

General contract for the erection of an $80,000 plant building for the Philadelphia Last & Pattern Co., Philadelphia, has been awarded the Hughes-Foulkrod Co. Carson & Carson are the architects in charge.

The Foundry Sand & Supply Co., Cleveland, has been incorporated with $25,000 capital stock by Harrison B. McGraw, Citizens building, Henry J. Piehl, Arthur D. Bender, T. H. Bushnell and B. K. Piehl.

The Velvet Seal Piston Ring Co., Cleveland, recently was incorporated with a capital stock of $500 by F. H. Kelsey, D. L. Sutter, A. Oleksza, J. J. Sloan and R. W. Roy.

The Stiegelmyer Mfg. Co., Seymour, Ind., has had plans prepared for the erection of a foundry building, 50 x 140 feet. Other buildings will be erected later it is understood.

Capitalized at $10,000 the Anderson Foundry Co., Chelsea, Mass., recently was incorporated by Peter Anderson and Eric G. J. Anderson, both of Medford, Mass., and Frank N. McIntire, Wakefield Mass.

The Barberton Foundry Co., Barberton, O., has started work on the erection of a group of factory buildings. These will be 40 x 200 feet, 40 x 80 feet and 40 x 60 feet. James Lanigan is president of the company.

A $40,000 foundry and machine shop addition, will be built by the Frost Mfg. Co., Kenosha, Wis., manufacturer of brass goods. The building will be 60 x 100 feet and the general contract has been let to the Kenosha Boiler & Steel Co.

Capitalized at $20,000 the Foundry Chaplet

& Supply Co., 2945 North Mozart street, Chicago, has been incorporated by W. B. Kilgore, W. O. Barthel and J. G. Stoeckert. The company is represented by Gann, Secord & Snead, 105 South La Salle street.

Work has been started on the erection of an addition to the plant of the American Foundry & Furnace Co., Bloomington, Ill. The building will be 50 x 86 feet. The company advises that all contracts for the construction and necessary equipment have been let.

The Boyd Wagner Co., 817-825 Washington boulevard, Chicago, has been incorporated with 150 shares of no par value to manufacture and deal in iron, steel, brass, and copper products, by John F. Boyd, Harry J. Wagner, Henry S. Lightall and others. The company is represented by Henry S. Lightall, 39 South La Salle street.

Contract for the erection of an addition to its plant has been let by the National Brass Co., Grand Rapids, Mich. The new building will contain 12,000 square feet of floor space and will house both brass and iron foundries. The company manufactures brass hardware. Officers are: President and manager, Lucien A. Dexter; vice president, W. W. Huelster and secretary-treasurer, E. N. Morrill. George D. Rice is sales manager.

The capital stock of the Tips Foundry & Machine Co., Austin, Tex., has been trebled and the name of the company changed to the Tips Engine Works. The company is gradually increasing its capacity and recently purchased additional machinery and equipment. Officers of the company are: President and general manager, Ralph C. Goeth; vice presidents, A. C. Goeth and Eugene Tips; secretary, Mrs. C. W. Gardner and superintendent, C. C. Smith.

Gray iron capacity of the Liberty Foundry Co., Wauwatosa, Wis., is being practically doubled by the erection of an addition, 80 x 120 feet, contracts for which have been awarded. Work on the structure will start at once. The general contract has been let to William F. Tubesing Co. The Liberty company was recently incorporated having been a partnership among Henry L. Grede, Ralph L. Lee and William J. Grede, who remain the principal stockholders and managing officers.

A charter has been granted to the American Tool & Production Co., Milwaukee, with a capital stock of $5000. The charter grants authority to manufacture and deal in machinery, metal goods and products, etc. E. C. Rosenberg, 114 Grand avenue, is attorney for the company.

The Colonial Brass Works, Inc., New Britain, Conn., has purchased the Baum electro-plating plant in Plainville, Conn., and will remove there June 1. Alterations will be made to the 2-story building to provide a foundry. The number of employes will be more than doubled.

Piston rings will be manufactured by the Myers Piston Ring Co., Columbus, O., which recently was organized with a capital stock of $50,000. The company does not plan to erect a new plant at present as it has obtained satisfactory quarters at 525 Buttles avenue. It will require some new equipment such as turret lathes, screw machines, automatic surface grinders and double milling machines. Officers of the company are: President, John F. Myers; vice president, Paul B. Coffman; secretary, T. A. Dean and treasurer, H. E. Coffman. A temporary office is being maintained in the Norwich hotel, Columbus, O.

Extensive alterations and additions to its main factory building have been completed by the Chantrell Hardware & Tool Co., Reading, Pa., The building has been modernized and another floor, giving an additional 16,000 square feet, added to it. The company does not plan to purchase any new equipment for this addition. In addition to the completed improvements the company has had plans prepared for the erection of a brass foundry building, 60 x 80 feet. This will be of modern construction and fireproof throughout. No new equipment will be needed for the structure, however, as the company's present brass foundry will be moved to the new building when completed.

New Trade Publications

ASH CONVEYOR—The Combustion Engineering Corp., New York, has published a 12-page illustrated booklet in which an ash conveyor system is described and illustrated. Details of construction are given.

PLATFORMS AND BOXES—The Truscon Steel Co., Youngstown, O., has published a 16-page illustrated booklet in which platforms and boxes and other equipment for handling material are described and illustrated.

CHUCKING MACHINE—A 4-page illustrated folder has been published by the Baird Machine Co., Bridgeport, Conn., in which a 6-spindle chucking machine is described and illustrated. According to the folder this machine handles five pieces of work at one time.

WATERPROOFING—The Truscon Laboratories, Detroit, has published an 8-page illustrated pamphlet containing a reprint of an article by Samuel R. T. Very, architect, on integral waterproofing. The article is based on data obtained by Mr. Very through a series of tests, and is a splendid contribution to the literature of concrete construction.

PANELS—Switchboard panels and supporting framework are described and illustrated in a 12-page illustrated booklet recently issued by the General Electric Co., Schenectady, N. Y. The switchboard panels appear under two general classifications, vertical and bench types. The data given in the booklet are interesting and should be of value to those contemplating switchboard installations.

STOKERS—The Combustion Engineering Corp., New York, has published a 24-page illustrated booklet in which automatic stokers are described and illustrated. The performance of these stokers on western and midwestern bituminous coal is pointed out. A number of test reports, each accompanied by corresponding curves, also are included. Illustrations of a number of installations are given in the booklet.

STANDARD BUILDINGS—The Truscon Steel Co., Youngstown, O., is circulating a 4-page illustrated folder in which standard industrial buildings are described and illustrated. These structures, which can be taken down and re-erected in new locations, serve admirably as factories, warehouses, shops, foundries, filling stations, freight sheds, garages, etc., according to the folder. They are of unit steel panel construction.

GENERAL CATALOG—The Link-Belt Co., Chicago, has published a new general catalog which embraces its entire line, and is the most complete one the company has ever issued. It contains 832 pages, is cloth bound, and not only includes the Link-Belt line but also the products of the H. W. Caldwell & Son Co., a subsidiary company. The contents include a description of chains and wheels, power transmission machinery, elevator boots, buckets, castings; conveyor equipment; boiler plant equipment; coal tipple equipment; locomotive coaling stations; car loaders and unloaders, locomotive and crawler type cranes; electric hoists; sand and gravel washing equipment, etc.

MULTI-SPEED MOTOR—The Louis Allis Co., Milwaukee, is circulating a 12-page booklet in which a multi-speed motor is described and illustrated. This motor operates on polyphase alternating current circuits with approximately the close control of varying speeds afforded by direct current motors having adjustable speed through field control. It is a squirrel cage motor with two or more stator windings independent of each other. Each winding develops a different speed. A drum controller or switch applies the current to any selected winding and the motor becomes a constant speed squirrel cage motor operating at the required speed. A complete description of the motor is given as well as data regarding its application to various tools, machines, etc.

PORTABLE TIMING DEVICE—The General Electric Co., Schenectady, N. Y., has published a 4-page illustrated folder in which a portable timing device is described and illustrated. This device was developed to obtain a secondary standard of time from which some of the limitations present in the stop watch have been eliminated and from which personal error has been obviated. Its greatest usefulness is in checking rotating standards or test meters, because its accuracy is within 0.1 second. It allows the use of the constant time interval method of checking rotating standards. Applications include use with graphic instruments; to measure angular velocity of rotating machinery; where a definite time interval is to be measured in the range of 1, 2 seconds and any whole number of minutes.

TRUCKS—The Sabin Machine Co., Cleveland, has published a 12-page illustrated booklet in which factory trucks are described and illustrated. Points of construction include a framework of electric steel castings with angle iron. The wheels are of semisteel, heavily ribbed to withstand shocks and are of large diameter to facilitate easy rolling. They are machine finished. Large bearings are properly mounted in the wheels. Axles are machined from 0.40 per cent carbon steel. An extension foot pedal is used on all trucks with the exception of one type. This increases the leverage and makes it easy for a man of medium build to break over loads up to 1600 pounds, eliminating the need for helpers. Steel handles are furnished as standard equipment and all trucks are equipped with legs so the trucks will stand in an upright position when not in use. Specifications and uses of the various types are given.

SPEED REDUCERS—Spur gear speed reducers are described and illustrated in a 96-page illustrated booklet recently published by the W. A. Jones Foundry & Machine Co., Chicago. This reducer is designed for stepping down speeds between electric motors and driven machines. This speed reducer is an enclosed spur gear drive, constructed so that all moving parts operate under favorable conditions in an oil bath. The high speed shaft and the low speed shaft are concentric and have the same direction of rotation. A flexible coupling connects the motor shaft to the high speed reducer shaft permitting the armature shaft of the motor, while operating, to float freely in its bearings. Another flexible coupling connects the low speed reducer shaft to the shaft of the driven unit causing rotation at any predetermined speed to suit the requirements. The final speed depends on the revolutions per minute at the motor and the reduction ratio selected in the reducer.